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Monthly Message

Ever since I have been in my present position, I have been extremely interested in the Industrial College of the Armed Forces and all that it has to offer the officers of the armed services and personnel from Federal departments and agencies. The ten months' resident course is comparable to a year's postgraduate course in general education given at our major universities. The faculty of the Industrial College is selected from the armed forces and civilian Federal departments. The majority of the lecturers come from all phases of our economy: leaders in business, government, history, economics, science, all the professions, civilian as well as military, and the major departments of our government. It has been my good fortune to appear as a visiting lecturer on two occasions.

Although military etiquette is punctiliously observed, the whole spirit is one of cooperation without thought of rank or service, except as each can contribute from his own experience. Authoritative reports are issued by the various teams into which the class is divided and formal graduation ceremonies are held at the end of each academic year.

In addition to the resident course, the college offers a correspondence course and presents National Defense Resources Conferences in different cities throughout the country. These conferences are conducted by faculty teams from the college for the benefit of reserve military officers and interested civilians in industry, commerce, government, the professions, and other walks of life.

Since the end of World War II, the college has been housed in inadequate facilities, a situation soon to be corrected. Lt. General G. W. Mundy, USAF, the present commandant, conferred a great honor on the medical profession, on 17 December 1958 by inviting me to participate with him in the ground-breaking ceremony for a new college building and to deliver a short address.

In preparation for this occasion I reviewed the record of participation by the medical and allied professions in the three courses offered by the Industrial College—alas all too small. Every opportunity should be taken to encourage medical department officers on active duty to apply for these courses and, with completion of new and larger quarters two years hence, additional positions for the resident course should be sought. Efforts also should be made to stimulate the interest of reserve Medical, Dental, and Medical Service Corps officers in taking the correspondence course and of civilian medical and allied personnel in attending the National Defense Resources Conferences.

After all, this strengthens the specialty of military medicine, which is not at all the same as "doctors in uniform."

Frank B. Berry

FRANK B. BERRY, M. D.
Assistant Secretary of Defense
(Health and Medical)

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Foreword

The *United States Armed Forces Medical Journal* is the medium for disseminating information of administrative and professional interest to all medical personnel of the Department of Defense. The Assistant Secretary of Defense (Health and Medical) and the Surgeons General of the several services invite all medical officers, dental officers, Medical Service Corps officers, Nurse Corps officers, and officers of the Veterinary Corps of the Armed Forces, and the medical consultants of the Army, Navy, and Air Force to submit manuscripts for publication in this *Journal*.

FRANK B. BERRY, M. D.,
Assistant Secretary of Defense (Health and Medical).

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Surgeon General, United States Army.

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UNITED STATES ARMED FORCES
MEDICAL JOURNAL

Volume X April 1959 Number 4

TENTH ANNIVERSARY OF SPACE MEDICINE RESEARCH IN THE U. S. AIR FORCE

The Origin of Space Medicine

HARRY G. ARMSTRONG, *Major General, USAF (MC) (Ret.)*

WHEN the history of the twentieth century is written some 50 or more years from now, it seems quite certain that space medicine's contributions to the advancement of civilization during the latter half of this century will receive prominent mention in any such account. If so, the writer of such a history will, under existing circumstances, be at a loss as to how, when, or where this new field of medicine came into being, for there now exists no written record of this event. It is the purpose of this report to provide this missing data.

While the advent of a new field of science is always a notable occasion, this is especially so in the case of space medicine because, among the various fields of military medicine currently being employed to support our military forces, space medicine unquestionably ranks number one in strategic importance. At the same time it occupies an eminent position in the general field of science in regard to its current and potential for future contributions to an understanding of nature's most closely guarded secrets. This latter will accrue from space medicine's key role in enabling man to travel in space. This is not an end in itself

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Presented on 9 February 1959 at the U. S. Air Force School of Aviation Medicine, Randolph Air Force Base, Texas, as part of a program in observance of the tenth anniversary of the establishment of the department (now division) of space medicine. General Armstrong, former surgeon general of the Air Force, was commandant of the school from July 1946 to June 1949.

but rather a means to an end whereby the outer reaches of the earth's atmosphere and the space beyond may be studied at first hand by scientists of all disciplines concerned with unraveling the mysteries of the universe.

In order that some of the difficulties surrounding the origin of space medicine may be understood, it is necessary to refer to the situation as it existed beginning in 1946. At the end of World War II, the U. S. Air Force School of Aviation Medicine lost essentially all of its research staff when those so engaged were released from the service and returned to civilian positions. The recruiting of a new research staff for the school was a slow and difficult process. It was not until about the end of 1948 that enough replacements were available to make it necessary for the various departmental programs to be reviewed and co-ordinated. In order to accomplish this, the heads of the various research departments were instructed, early in January 1949, to prepare long-range plans for their respective departments and submit them to the commandant for co-ordination and approval.

Among others, there was a plan submitted by Professor Hubertus Strughold recommending that a new department with the responsibility of studying the human problems of space flight be established at the school. This plan had been evolved by Professor Strughold after consultation with a fellow staff member, Dr. Heinz Haber, who also was interested in such an undertaking.

If Professor Strughold's proposal had been delayed 10 years, that is until today, it would be universally regarded as an obviously needed—in fact, an urgently required—program. Conditions, however, were quite different in 1949, and the plan had to be formulated by Professor Strughold and evaluated by the school in the face of the following circumstances. At the time, our military strength in general and our military research and development programs in particular were being sharply curtailed as an economy measure. For example, the Air Force had let a research and development contract for the Atlas missile in 1946 but was forced to cancel it in 1947 due to lack of funds. Between 1947 and the date Dr. Strughold submitted his plan, no other Air Force contracts for similar missiles had been let, so that at first glance his proposal resembled a suggestion that a cure be developed for a disease that did not exist.

In addition to this state of affairs external to the school, there were two internal problems that had to be considered. The first of these was the extremely limited assets available to the school at that time, which meant that only projects of the highest priority and of immediate concern should be authorized. The second problem had to do with the possible reaction that might occur if the school were to expend scarce man-hours and funds on a matter that was familiar to the public only through the comic strips of the daily newspapers and the weekly comic magazines. Under those circumstances a press story questioning the wisdom

of the proposed studies or one that made light of them could very well have triggered a public and official reaction of such proportions that the school's entire research program could have been placed in serious jeopardy.

After assessing the validity of these various possible objections to the proposed laboratory, it was concluded that none of them were of overriding importance for the following reasons. From an engineering viewpoint it was known that a man-carrying space vehicle could be designed and constructed, and the tremendous military and scientific value of such a device was quite obvious to those qualified to judge such matters. Based on these considerations it seemed certain that such a vehicle would be built as soon as its worth was more generally recognized. The time factor involved was estimated to range somewhere between 10 and 20 years.

The question as to whether or not the proposed study was of immediate practical importance was decided in the affirmative, based on an estimate that a lead time of 10 to 15 years would be required to work out the essential medical problems involved, which dovetailed nicely with the time estimate of the availability of an operational space ship. In the interim, the accumulating medical data would have useful sequential application to the altitude problems which would be created by the new jet and rocket-propelled aircraft then being constructed or in the planning stages.

That news stories concerning the new laboratory might be written in an ironic or satirical vein to bring the school into public and official disrepute was never given very serious consideration. In dealing personally with the general press over a period of some 15 years, its reporting of scientific matters had always been observed to be entirely objective and constructive in its attitude. Consequently, it was thought that this same thing would apply in this instance, and subsequent events proved that assumption to be correct.

By this time it should be quite evident that Professor Strughold's proposal was to be approved, but before final action could be taken a name had to be selected for the new laboratory. This proved to be an unexpectedly difficult task because there were literally dozens of terms that were generally suitable but lacked the exact shade of meaning that would make them technically correct. Finally, the term "space medicine" was recommended by Professor Strughold and was adopted. This term has stood the test of time and the basic term "space" has, since that time, been almost universally accepted by other scientific disciplines, and the terms space travel, space probes, space suits, and others have become a part of our everyday, as well as our scientific, language.

The matter of terminology having been decided upon, an official order was issued by the U. S. Air Force School of Aviation Medicine creating a department of space medicine within the research division of the school. The effective date of this order was 9 February 1949. Initially the commandant of the school assumed the added responsibility as director of the new department in order to expedite its organization and to permit its newly assigned staff members, Professor Strughold and Dr. Heinz Haber, to devote full time to initiating a research program. As soon as the new department was well established and functioning, however, the commandant relinquished this added duty and Professor Strughold was appointed as the first permanent chief of the new laboratory in May of 1949.

Shortly thereafter, two other members of the school's research staff also began working in this new laboratory and thus share in the honor of having pioneered in this new field of science. I refer to Professor Konrad J. K. Buettner, an environmental physicist, and Dr. Fritz Haber, an aeronautical engineer.

The School of Aviation Medicine is to be commended for commemorating the tenth anniversary of the founding of the department of space medicine, for bringing these four pioneers of this important new science together here today as honored guests, and for having them present the major portion of this program.

For my own part I should like to pay tribute to Professor Strughold, Dr. Heinz Haber, Professor Buettner, and Dr. Fritz Haber for their foresightedness, imagination, and courage in their pioneering efforts in, and their subsequent brilliant contributions to, the advancement of space medicine. For their efforts in this regard they are entitled to a profound feeling of personal satisfaction, the highest regard of those who are privileged to count them as friends, and the gratitude of our nation whose interest they have so ably served.

The Present Space Medicine Effort at the School of Aviation Medicine

PAUL A. CAMPBELL, *Colonel, USAF (MC)*

TODAY, 9 February 1959, 10 years after the founding of the Department of Space Medicine, one can safely say that space medicine has spread into each division, every department of the School of Aviation Medicine, and every nook and corner. The over-all effort in space medicine and space biology is co-ordinated through a space co-ordinating committee

Dr. Campbell is the chief, Division of Space Medicine, U. S. Air Force School of Aviation Medicine, Randolph Air Force Base, Texas.

—the research effort, through the Directorate of Research; and the teaching effort through the Directorate of Education.

Since its inception there have been no true divisional or departmental barriers at the School of Aviation Medicine. The team concept has been the rule. Divisional and departmental segmentalization has existed solely for administrative purposes.

Let us first consider the teaching effort. Here it must be pointed out that almost all of our teaching personnel are involved in research, and almost all of our research personnel in teaching.

As is quite evident to this audience, it is difficult, if not impossible, to draw a line and say—this is where aviation medicine ends, and this is where space medicine begins—but it is our duty to take the younger doctors who are in the primary and advanced courses of aviation medicine and extend their horizons into the space concept, and to take the more mature flight surgeons and, through refresher courses, keep them informed of the effects of missilry on their jobs and the effects of the space concept on their profession.

Various support groups, such as the physiological training officers group, are also brought in from time to time for a review and for extension of their horizons. I believe it can be truthfully said that the School of Aviation Medicine is the only institution of the free world, and possibly of the entire world, with an organized sustained program for training relatively large groups of people in space medicine.

The impact of this program is evident from another point of view: large numbers of visitors from other institutions, industry, other government agencies, information medias, and so forth, visit the school in quite substantial numbers for briefing and consultation. Through the organization of symposia, such as that held last November on the subject of medicine and physics of the atmosphere and space,[1] and participation in programs throughout the country and free world, the new knowledge produced or organized by the School of Aviation Medicine is projected far and wide.

The research effort in space medicine and space biology is also spread throughout the school. The School of Aviation Medicine, U. S. Air Force, is the direct lineal descendant of the original unit at Hazelhurst Field, Mineola, Long Island, of World War I, extending through the School at Brooks Field of the twenties, and has been on Randolph Air Force Base since 1931. Since its beginning at Mineola the School of Aviation Medicine always has had as a major mission, and what is probably its most important research mission, the research and development of physical, physiologic and psychologic

criteria for selection of flight personnel. Within its environs, its records, and within its people has accumulated the world's greatest storehouse of knowledge in this field. In every department this specialized knowledge, nurtured by validation projects, consultations, and so forth, is being extrapolated into the space concept. Other than in the field of selection, the broader efforts in space medicine are in the Space Medicine Division (which I shall come back to later), the department of radiobiology and the departments of physiology and biophysics. The departments of physiology and biophysics have, in cooperation with the department of radiobiology, developed the basic research and important hardware for mouse and primate biopack units; and have trained, acclimatized, and conditioned animals for future adventures into space. They have also developed or have selected and modified miniature instruments for the recording or telemetering of the required information. Another effort in this department is concerned with studies of the effects of acclimatization and conditioning in relation to the various parameters of space flight.

The Space Medicine Division is a direct outgrowth of the Department of Space Medicine. It is now divided into four departments: astroecology, biogravics, bioastrophysics and bioastronautics. The Department of Astroecology is concerned with the development of closed ecologic systems in which man can live in his own little encapsulated world with only those resources that can be carried along, or extracted from the energies of space. All the contents must be selected within the framework of minimum weight allowances, miniaturization from the standpoint of volume, and maximum conservation. The recycling of nutrients, fluids, and vital gases are under study. To meet these ends a series of studies have been completed for the development of base lines measuring most of the more important parameters of the individual in the isolated environment of the space cabin simulator for long periods of time. Now the studies are being directed toward weight and capacity reduction. Whereas it took a daily weight of about 100 pounds in food, oxygen, fluid, absorbents, and containers to support Airman Farrell in his well-known 7-day run, ideally it should only require about 40 pounds a day. In present studies it is hoped to bring these figures together. From our studies it has become quite evident that a space cabin simulator will be an extremely necessary selection and indoctrination device for manned space flight. A new sealed cabin (fig. 1), much more efficient than the present one, is now under construction and will be completed shortly after the move into our new facilities at Brooks Air Force Base.

Another study is under way concerning the use of algae, and so forth, as biological gas exchangers (fig. 2). Mice now

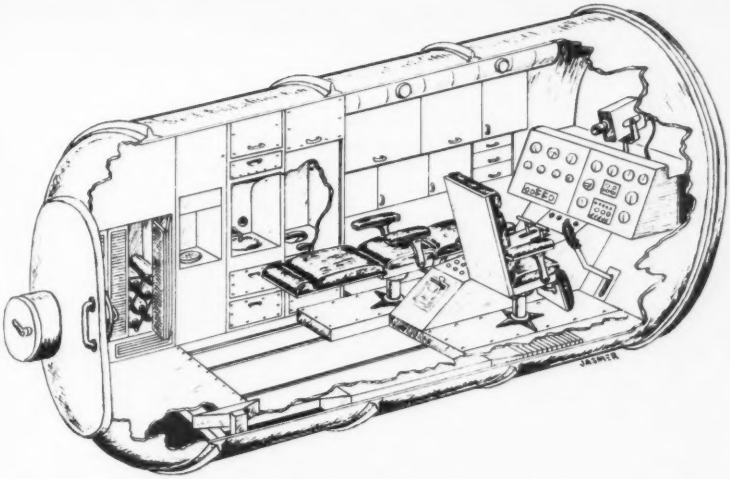

Figure 1. Space cabin simulator under construction for space medicine division, U. S. Air Force School of Aviation Medicine.

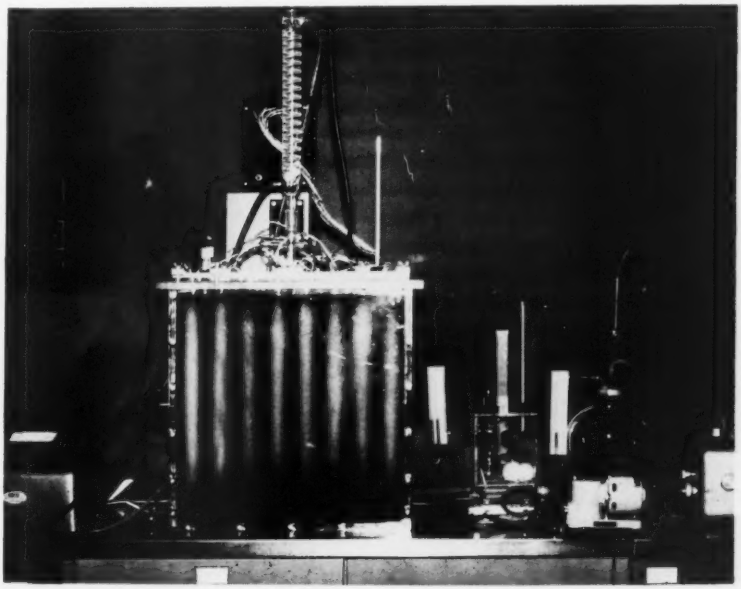

Figure 2. Biological gas exchanger using algae presently in use at the U. S. Air Force School of Aviation Medicine.

can be kept alive for long periods in this system. I am told that recently four mice were kept alive in a small closed system for 27 days. The state of the art of such biological gas exchangers is improving in leaps and bounds. In explanation of

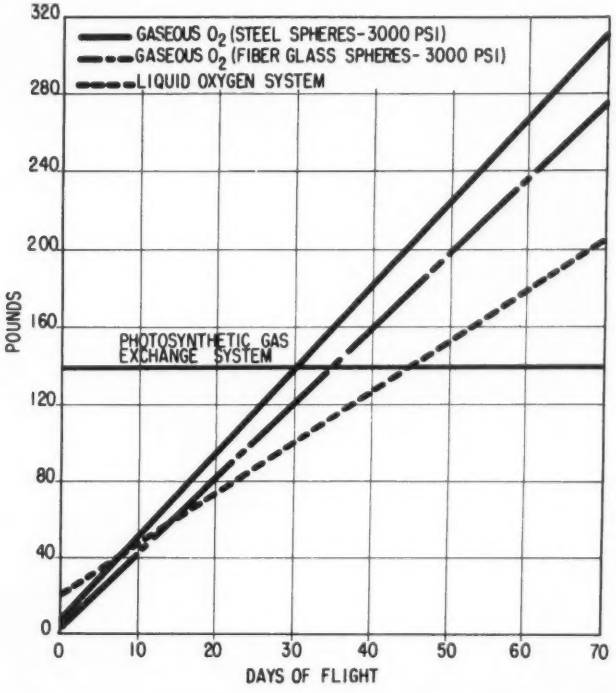

Figure 3. Comparison of oxygen supply systems for human space flight based upon the following considerations: (1) The astronaut would require 875 grams of oxygen per day. (2) No penalty is applied to the various oxygen-supplying systems for their inability to utilize carbon dioxide. (3) At present there is very little information concerning possible power sources for utilization in space, consequently the weight and effectiveness of these sources have been omitted from the computations.

this effort, figure 3 demonstrates the weight costs of the various types of oxygen supply for the astronaut in terms of the time periods during which their efficiency becomes manifest. As can be seen, space flight for long periods probably will require a biological gas exchanger of some type. Space stations or bubble colonies will most certainly require them.

The department of biogravics is concerned with studies of the effects of weightlessness on man. Through flights along Keplerian parabolas, they began with the ideas of the pioneers

who are here today, then carried them into T-33 aircraft operations, then the faster F-94s, and now are ready to utilize the Century series of aircraft. Time in the weightless state has been extended into periods of more than 40 seconds, and soon will be increased to a period near a minute .Some of our people have accumulated many hours in the weightless state. One pilot who recently left had flown more than 2,200 parabolas. Again our studies point to the necessity of using such a device for selection, indoctrination, and training for space flight.

Bioastrophysics is concerned at this time with the design and instrumentation for the other departments. With changing concepts, new ideas, and the development of the art, this is a huge task and demands pioneering efforts.

Bioastronautics, our fourth and newest department, is just now in the course of organization. It will be under the able leadership of Lieutenant Colonel David Simons, who is a pioneer in space medicine in his own right.

In conclusion, I am certain that we all hope to return on the twentieth birthday of the department of space medicine to see what has been accomplished in the decade which will place man in space, and possibly among the planets.

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Space Medicine of the Next Decade as Viewed by a Physician and Physiologist

HUBERTUS STRUGHOLD, *M. D., Ph. D.*

I FEEL very honored to open the series of discussions of the protomembers of the department of space medicine—Dr. Heinz Haber, Dr. Konrad Buettner and Dr. Fritz Haber—on space medicine within the next decade as viewed by a physician and physiologist.

Crystal-ball gazing can include the following approaches or features: logical extrapolation, imagination, speculation, fantasy, and illusions. Sound crystal-ball gazing, of course, always has to contain a dosis of horse sense. In this, my space-medical crystal-ball gazing, I shall try to keep within the limits of logical extrapolation, imagination, and horse sense.

Dr. Strughold is professor of space medicine and advisor for research, U. S. Air Force School of Aviation Medicine, Randolph Air Force Base, Texas.

Basically, the time table in astronautics will be determined by the physical sciences, technology, and the rocket industry. The predictions made from this side usually are realistic and therefore dependable; despite this, they occasionally unexpectedly become outdated by so-called breakthroughs in this or that field and in this or another country.

Recently the Select Committee on Astronautics and Space Exploration of the House of Representatives published a collection of predictions of 56 scientists, engineers, industrialists, military officials,. and government administrators on the next 10 years in space. These predictions ranged from new shock-producing surprises to ultraconservative opinions. Manned space flight played in these statements an important role. And here is the area where space medicine enters the picture.

In a life science such as space medicine, predictions following a strict timetable are somewhat strange, especially because the pace of the advance on the ladder into space will be determined in the technologic sector of astronautics in the first place, as already mentioned. We in the medical sector must carefully consider the various kinds of space operations (table 1), the pertinent types of vehicles (fig. 1), and propulsion methods and their thrusts that are proposed by technology. We then must have a sense for estimating their prospects and limitations from a medical point of view and must develop a research program that can improve the prospects and shift the limitations. Only in this sense do I dare to make some predictions from the point of view of space medicine.

A brief review of space medicine in the next 10 years can, essentially, be only a consideration of what should be done and what actually can be achieved during this period of time to further man's advance on the vertical frontier. But I also should like to mention that some research that will be done during this time will not bear fruit until perhaps 20 years from now, or even later.

Space medicine, like aviation medicine, belongs in the category of industrial and environmental medicine. Its industrial medical tasks are centered around the launching sites which exhibit all the hazardous features of a giant factory, such as dangerous fuels accumulated en masse, noise, tight time schedules during countdown, et cetera. At present, we are principally concerned with the toxicity of classical liquid fuels, the propellants characteristic of the so-called first generation of rockets. These will be replaced by exotic fuels in different states of aggregation. In 10 years, semisolid and solid fuels will be essentially the concern of the doctor assigned to duty on launching sites such as Cape Canaveral or Vandenberg Air Force Base. The Minuteman rocket is the best known representative of this

development. With this evolution of propellants, space medical toxicology will become exotic.

As an environmental science, space medicine encompasses a much greater area of interest: the biophysics of the environment of space; the artificial environment to be created in the cabin; and the biodynamics of the vehicle moving to, through, and returning from the environment of space.

Concerning the biophysics or ecology of the space environment, its basic biocidal quality is generally understood. Within the next five years much of the exploratory efforts will be devoted to the study of the topographic and temporal environmental variations or differences in space. They can present specific danger zones or time periods of increased hazards for manned space operations. Several years from now we shall have sufficient knowledge about the topographic intensity distribution of James Van Allen's great radiation belt for biological evaluation. Even now it can be said that—for safety reasons—the arena for manned satellite operations will be only 500 miles wide, reaching from 120 to about 600 miles. The two cores of the radiation belt will be off limits for manned space flight; whether or not orbiting through the corridor between them, that is, between 4,000 and 8,000 miles, is medically permissible will be a matter of navigation precision and further exploration.

In contrast to these nearby-space operations, this great radiation belt will pose even greater difficulties to deep space operations. Nearby space can be defined as that region within which the earth's influence by its solid body, its atmosphere, and especially by its magnetic field upon the ecologic qualities of space is distinctly recognizable. Beyond this region—determined by the outer boundary of the great radiation belt—we enter deep space which blends with interplanetary space at a distance of about one million miles, the region of the gravitational divide between the earth and the sun. Manned deep-space operations, whether with subescape or escape velocities, probably will be achieved around the end of the next decade. Before this time, concerning the great radiation belt, we have to know what protective measures we have to take: evasive action through the polar regions, higher velocity, shielding, or a combination of all of them, or a combination of some of them. In deep-space operations the knowledge of meteor streams will also become important and will have to be explored by deep-space probes. The results of all these probes will enable us to draw up a space chart or space map about the biophysical conditions encountered in the void between us and other celestial bodies. Such an ecologic cartography of space, or briefly spatiography, will to a great extent be based on considerations concerned with hazards for the crew and will become routine teaching material at universities and high schools. For astronautics, advance knowledge of all of this is just as important as it is for the captain of a

TABLE 1. *Present and future basic stages of human flight*

	I	II	III	IV
Classification of flight	Atmospheric flight	Space-equivalent flight	Satellite flight	Lunar, interplanetary, planetary missions
Status of vehicle	Airplane	Airplane or projectile	Satellite	Space ship
Characteristics: Environment	Troposphere, lower stratosphere	Partial space-equivalent regions of atmosphere	Total space-equivalent regions of atmosphere and near by space	Space
Dynamics	Aerodynamics	Aerothermodynamics ballistics	Celestial mechanics	Celestial mechanics
Speed or velocity	Subsonic, supersonic speeds	Supersonic, hypersonic speeds	Orbital velocities	Escape velocities
Gravitational condition	Normal gravity	Subgravity zerogravity	Zerogravity	Zerogravity

ship to have information about the wind and water currents and routes of icebergs and cliffs in the ocean on his way to an island.

The target islands in space are the moon, Mars, and Venus—the latter with a question mark. Venusian probes within the next 10 years will have cleared up the question of whether or not it is true that in the direction of Venus we run into the outskirts of the solar corona, and if it is true that the temperature on Venus reaches biocidal levels due to a greenhouse effect in

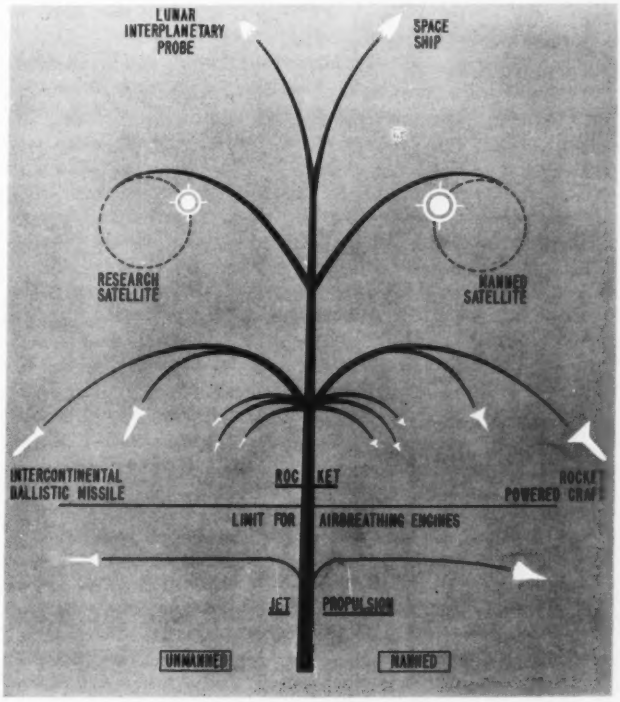

Figure 1. Family tree of rockets and space vehicles.

its carbon-dioxide enriched atmosphere, as Gerard Kuiper expects it to be. We still do not know if Mars, probably the only sure target planet for exploration, is a red and green planet, that is, are the green areas real or a visual contrast phenomenon. Only from a distance of a quarter of a million kilometers are such dark areas as the Syrtis Major large enough to be recognized in their true color by the unaided eye. Green or not green, it does not exclude the possibility of life on Mars. In the future all astronomers should get their color vision examined; also the astronaut should have normal color vision so that the information he brings or sends back about the optical world in space is reliable.

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Space medicine also will be concerned in the evaluation of increased solar activity, which is the essential cause of temporal variations in the particle and electromagnetic radiation climate. With them, the solar 11-year cycle enters the program of scheduling space operations of both nearby and deep-space operations.

But the principal field of work for the space doctor is not the physiologic evaluation of the external environmental factors; it lies inside the space cabin, creating an intracabin environment to meet the climatic, respiratory, nutritional and anthropometric requirements of the astronaut in terms of economic logistics.

To keep a man alive and alert in a completely sealed compartment is the *suprema lex* in the space medical efforts and the prerequisite for all other questions. What possibilities does space medicine offer in this respect today, and what will it be able to offer in the next 10 years? The crucial point in this question is the time factor, that is, the duration of the flight. For a better understanding of this vital problem we must remember that there are two methods or stages for providing the respiratory and nutritional necessities.

The first stage is accomplished by replacing the consumed materials from stores and the storing and/or elimination of waste products. This method is based on physical and chemical procedures and has been used and tested in experiments carried out in the space cabin simulator at the School of Aviation Medicine for four years. It was also the method of Lieutenant Colonel David G. Simons in his space-equivalent balloon flight in 1957 and those of the U. S. Navy. As proved by more recent space cabin simulator experiments, the duration of keeping a man alive and alert in a sealed cabin can now be expressed better in weeks than of days. Nearby space and deep-space flights, as they are in the capability range of the program of the National Aeronautics and Space Agency in the coming years, could be handled with these physical means of replacing and storing, if their duration remains in the order of weeks. It all depends on the permissible payload. The introduction of new exotic absorbents for carbon dioxide and humidity also might improve the time limitation. It seems to me that a more refined physicochemical system will be the method for the regeneration of the intracabin environment for the next 10 years. It would allow circumlunar and lunar missions and deep-space penetrations approaching the duration of one or two months. Beyond a certain time, however, we must resort to another method: recycling; namely recycling of all the vital bioelements like oxygen, carbon, and nitrogen in the same manner as observed in free nature, for instance in the process of photosynthesis in green plants. With this stage, we deal with a true closed ecologic system. This is *the* method for long voyages such

as in interplanetary and planetary missions. This method will not be operationally available within the next 10 years and probably will not be required during that time. Intensive efforts, however, must be made and will be made within this decade in this field to make recycling available for the decade thereafter. Considerable progress has been made during the past four years in studies on algae in a photosynthesarium. More and more efficient strains of algae have been found, not only to recycle the gaseous components of metabolism, but also the fluid and semifluid waste products. The principal difficulties in these biological gas exchangers lie in the size of the device, the volume of the nutrient solution, and in illumination. With regard to the light source, solar light may be the answer. But photosynthesis did not start on earth on the basis of visible light. It started with infrared rays. This is thermosynthesis. Apparently at that time, some two billion years ago, the earth's atmosphere was not as transparent as today. Some micro-organisms of this kind, namely purple bacteria, still exist. But in thermosynthesis only carbohydrates are produced, and no oxygen. Within the next 10 years efforts will be made to find, perhaps, an effective thermosynthesis or some transition stages between photosynthesis and thermosynthesis. To work for the future, we sometimes must look back into the past and also to the far distant celestial bodies. For instance, G. Tikhov at Alma Ata, USSR, believes that the green vegetation on Mars uses infrared for "photosynthesis." He concludes this from spectrographic studies of these areas.

Photosynthesis is a process taking place within the cells. Extracellular photosynthesis is the next method we will look for within the next 10 years. This leads to artificial photosynthesis, which may be one of the solutions.

These are the areas with which space medicine will be concerned in the coming decade in order to develop an efficient closed ecologic system useable for space operations of long duration, such as a trip to Mars. Because of the limited time, I cannot go into other important research areas such as day-night cycling, psychologic problems, flight dynamics, et cetera. I have concentrated on the closed ecologic system because the construction of a synthetic little earth is the prerequisite of the entire space adventure. It must take care of the astronaut and his vital necessities in a similar manner as does the earth on a gigantic scale for its two billion people.

So far I have discussed space medicine as an applied science —applied to furthering manned space flight. I should like to make a few remarks about how space medicine will influence our thinking and methods in medicine in general in the future.

There is no question that space medicine has already broadened our medical and physiologic thinking in the direction of a cosmic spectrum that will pay off and will be of benefit to the progress in earthbound medicine. For example, we do not find the word "weightlessness" in the text and handbooks of medicine and physiology, and yet numerous experiments on the statokinetic reflexes, on the fall reaction of the cat in which weightlessness is involved, have been carried out and described in the twenties. It had been completely overlooked, however, until the first theoretical space medical papers 10 years ago brought it to our attention.

Today, we observe almost a boom in weightlessness, especially in the popular literature. In scientific papers and lectures we begin to speak of a special category of gravireceptors and antigravireflexes. The study of circulation under zero gravity —in which the hydrostatic pressure does not exist—will give us a better understanding of hemodynamics. Following a lecture at the University of Maryland two months ago, someone asked me the question: What would happen to a baby born under zero gravity conditions? I think a speculative study of this question would be worthwhile, especially when we consider that a child's biggest problem during its second year is the constant battle with the earth's gravity. A hypothetical zero-gravity baby brought, after some time, into the earth's gravity would probably first learn to swim and then later to walk, following the developmental pattern in paleontology.

Now, let's take the closed ecologic system again. Experimentation in this field is novel in the history of medicine and biology. New methods for recording environmental factors, such as oxygen and carbon dioxide pressures, and physiologic processes are being developed, all based on the principle of minimization in weight and miniaturization in volume and with the possibility of telemetry. From this astroinstrumentation, even hospitals will benefit. I should like to remind you that a micromanometer to measure the blood pressure within the heart was developed by aeromedical scientists. Colonel John P. Stapp's biodynamic experiments on the rocket-powered sled, carried out in respect to the high G's during launching and atmospheric re-entry, also are extremely valuable for the medical analysis of automobile accidents. One could relate many more examples.

An entire medical astroglossary will be developed within the next 10 years, which will not only serve its purpose in astronautics but also help to clarify definitions in terrestrial medicine.

Several hundred years ago, with the invention of the microscope and the subsequent discovery of cells and bacteria, medicine learned about the riddles of the microcosmos. Now, with the development of giant rockets, medicine in its youngest branch, space medicine, has the unique opportunity to aid tech-

nology to open the gates into the distant world of the macrocosmos. With this, the cosmic spectrum of medicine is complete.

We live, indeed, in a wonderful era of science and technology, in a cosmic era for the first time in human history. It is gratifying to see that medicine will play in this cosmic era an important, in fact, a decisive role. To witness this is perhaps the greatest reward for all of those who have been associated with the foundation of space medicine in the past, and it will be a stimulus for the medical and biological researchers of the future.

I wish to conclude this presentation with a salute to Major General Harry G. Armstrong who 10 years ago, by founding the Department of Space Medicine, established an official platform for the start of these cosmic medical studies.

Space Medicine of the Next Decade as Viewed by an Astrophysicist

HEINZ HABER, *Ph. D.*

AN ANNIVERSARY is an excellent opportunity to look into the past, to assess the situation of the present, and to attempt a forecast of the future. We must be grateful to General Benson for having recognized that the tenth anniversary of the foundation of the department of space medicine is such a unique opportunity, and we also must be grateful to him for having invited to his headquarters all those who had a hand in the initiation of the field of space medicine a decade ago. To us, then, this opportunity is also an obligation. I, for one, have given much thought to the ideas one should present on this occasion—ideas that live up to this obligation. One almost feels like a parent who watches his child grow up. Space medicine has truly grown during the first 10 years of its life. Today we might say that our branch of science, while not yet fully mature, is certainly no less than a teen-ager. And like all teenagers our child is strong and promising but it also has its problems and growing pains.

My mission is to give an astrophysicist's view of the next decade of space medicine. I believe that this can best be done by bringing up to date a paper which was written shortly after the foundation of space medicine. The title of this paper was: "Phasing and Coordination of Medical Research with Technical and Environmental Development."[1] A re-reading of this paper

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shows that one essential error of judgment was committed, namely the estimate of the development of the space flight and space medicine timetable has been too conservative. The dreams of yesterday have become the realities of today much faster than anticipated. So far as man's environment in space is concerned, the most important and interesting change has been the recent discovery of the intense band of radiation enveloping the earth which now bears the name of its discoverer, namely the "Van Allen belt."[2] It is of particular interest to note that the Van Allen belt was discovered through measurements made with the "Explorer satellites," that is this discovery is a direct outcome of the fast-growing space sciences.

In order to assess the future of the space sciences and the role of space medicine in the next decade, it appears expedient to subdivide the presumable development into three different phases, namely the present, the future comprising perhaps the period from two to eight years from now, and the final phase that could possibly be reached at the end of the coming decade. The types of vehicles, unmanned and manned, that are and will be used in these different phases are: instrumented and animal-carrying satellites, lunar and planetary probes; and in the manned variety: high-performance jet and rocket aircraft, rocket aircraft of the X-15 type with eventual orbiting capabilities, permanent manned satellites, and manned lunar ships. For each of these vehicles we can assign certain geophysical and astrophysical types of environment that can be subdivided into essentially four types. The vehicles, the types of environment, the duration of exposure to these environments, and their arrangement within the three time phases, namely the present, the future, and the final phases, are shown in table 1.

The four types of environment listed here can also be taken as the basis for a space-medical research program for the coming decade. In detail the characteristics of the four types of environment are the following:

Type I. This type is the environment of the stratosphere and of the conventional jet- and rocket-powered aircraft existing today. Characteristics are insufficient air pressure and oxygen partial pressure, high g-forces in certain maneuvers, and difficult escape problems.

Type II. This type is the environment of extraterrestrial space in the proximity of the earth, of satellites and their launching vehicles. Characteristics are complete absence of air and oxygen, radiation climate, absence of diffuse illumination, presence of unmitigated solar radiation (ultraviolet and x-rays), cosmic rays behind the geomagnetic shield, intense radiation from the Van Allen belt, hazards from meteorite punctures, weightlessness, acceleration and temperature problems during ascent and re-entry, and escape problems of extreme severity.

Type III. This type is the environment of extraterrestrial space, of the lunar surface experienced by lunar probes and lunar ships. Characteristics are the same as for Type II plus these additional factors: full isotropic frequency of meteorites and intensity of cosmic rays, including possible bursts from short-term excessive solar activities; continued exposure to full solar radiation; lowered gravitational field of the moon, temperature extremes of lunar surface; possible radioactivity of lunar surface induced by secular cosmic radiation; and escape problems of extreme severity. According to recent data, intensity of radiation in the Van Allen belt is restricted to comparative proximity of the planet Earth.

TABLE 1. *Phasing and co-ordination of space technology and environment*

Vehicle	Present aircraft	Satellites	Lunar vehicles	Planetary vehicles
Environment	Type I	Type II	Type III	Type IV
Present	Manned jet—and rocket aircraft. Exposure time: hours	Permanent instrumented and animal-carrying satellites. Exposure time: days to years		
Future		Manned rocket aircraft of the X-15 type. Exposure time: minutes Manned orbital vehicles. Exposure time: hours Permanent manned satellites. Exposure time: days—weeks	Instrumented lunar probes. Exposure time: weeks	
Final			Manned lunar ships. Exposure time: weeks	Instrumented planetary probes. Exposure time: months to years

Type IV. This type is the environment of extraterrestrial space and of the surfaces and atmospheres of other planets. Characteristics: Same as Type II and III plus the physical and chemical factors governing the surfaces and atmospheres of other planets.

All these geophysical and astrophysical factors of the space environment must be evaluated in terms of the expected duration of exposure. This is particularly significant with regard to the radiation problem which is the only major space-medical problem that has assumed an entirely new dimension as a result of recent discoveries.

PHILOSOPHIC AND SOCIOLOGIC ASPECTS OF SPACE MEDICINE

I mentioned before that an occasion such as this anniversary implies an obligation, and I believe that I could not fulfill this obligation if I did not go beyond a mere scientific discussion.

I hope that I may be permitted to delve into the philosophic and sociologic aspects of space medicine and space science as a whole. I may be permitted to do this if only for one reason. During the past five years a major portion of my time was spent in an area that I choose to call "public science," by which I understand the attitude, recognition or nonrecognition of the scientific age, particularly in our case the space age, by the general public, and also the relationship and the obligations of the scientist to the public. The importance of "public science" is highlighted by the ever-increasing sums of public money that are spent on science in connection with the defense effort. Today space medicine and space exploration receive a formidable share of this public money, and this fact encourages me to look more closely into the relationships between space exploration and public science. In particular, I want to look into the question to what extent the space age and our work in it and for it are correctly understood by the public.

What I have said so far is perhaps none too clear, and I would like to clarify it by an example, namely, atomic energy. The atom and its energy have entered the stage of our modern world as the most fearful and devastating force ever unleashed by man. The potential military applications of atomic energy completely dominate the political situation of the world today. In fact, without atomic and hydrogen bombs the cold war would lose much of its fierceness and deep chill. It is this aspect of atomic energy that justly captivates the mind of the world public. If the word "atom" is mentioned everyone immediately associates with it the anxieties of the cold war, the insidious dangers of radioactive fallout, and the horrifying prospects of a world wide holocaust of unleashed nuclear forces that could well wipe the phenomenon of life off the face of this planet. But atomic energy is only a force of nature that is neither good nor evil; only what we ourselves make of it renders it good or evil. But the fact remains that the public relations of the atom are extremely bad, and I am afraid that atomic energy will never be able to live down the deplorable circumstances of its birth as a useful power of nature. And yet, without atomic energy, particularly without the still unharnessed power of fusion, world civilization is bound to wither from energy starvation. There exists an alarming discrepancy between the vital importance of atomic energy on the one side, and its reputation in the mind of the world public on the other.

How then does space exploration, the second great scientific adventure of our time, fare in this respect? Its beginnings were most hopeful. The first true space project, namely the artificial satellites, originally was introduced to the world as a scientific experiment to be conducted in connection with the International

Geophysical Year (IGY). When in July 1955 the White House announced the "Vanguard" project to the world, it was most gratifying to all scientists to learn that man's first venture into space was to be a noble undertaking designed to enhance the progress of the sciences. This development came as a tremendous relief to all scientists who had been worrying a lot about the reputation science had acquired in the public's mind, namely, that it was the prime role of science to be the handmaiden of warfare. Instead, space exploration was to proceed as an integral part of the IGY, this great international research effort which was launched under the fortunate auspices of international co-operation and peaceful intentions. So far as public science was concerned, the years 1955 to 1957 were the golden age of space exploration even though not a single satellite had yet been launched.

Then came the first Sputnik. The entire situation changed overnight. So far as the world public was concerned, the satellites were no longer tools of earth research. No, they became symbols of a nation's capabilities to wage war and they became tools to impress the world with one's technical superiority and capacity for world leadership. The scientific significance of these magnificent experiments was forgotten almost completely and the International Geophysical Year lost its charm. What was destined to be the most glamorous showpiece of public relations for the IGY turned out to be a heavy liability. True, the IGY remained a great scientific success but it had lost its power as a symbol of international peaceful co-operation of our time. The true meaning of satellites was lost, too. This was highlighted most succinctly by the terse caption given to the Sputnik story by a European news magazine: "The Propaganda Moon." And what is most deplorable of all, the noble idea of space exploration in the service of science for the benefit of mankind had suffered the same fate as atomic energy. In the public's mind space and the atom are now both tools of power.

SPACE EXPLORATION AND NATIONAL DEFENSE

As a realist I fully acknowledge the situation at hand. This country has no choice but to make tremendous efforts in the field of space exploration in the interest of national defense and the world-wide reputation of the United States as a major technological power. I feel this way as a citizen and as a taxpayer. But as a scientist with certain ideals I must confess that I deeply deplore this situation. As scientists we are bound to feel this way not because we are hopeless idealists but because we deplore this situation in view of the future of science and its reputation in the public eye. We are fortunate to live in a country that has always cherished the ideals of democracy and that has grown to be great because of them.

Today, science has become a public affair of the greatest importance, but little is done to acknowledge this democratic fact. On the contrary, the present situation of space science has the public in a state of utter confusion about the role of science and scientists in our civilization. We are scientists. We know what we are and what our work is meant to be, but we should worry about what the public thinks we are and what our work means. If the public does not understand completely the motivations of scientists and the true meaning of science, we shall not be able to secure public support for future projects unless they can be justified on the basis of military necessity. Yet, science is more than the design of military hardware but the public doesn't seem to think so. Space science today is in an extremely exposed position because the world public is keenly aware of its importance as an international propaganda weapon. There is considerable danger that science will suffer in the long run by such a stark misinterpretation of its true meaning in the mind of the public.

LAUNCHING OF A LUNAR PROBE

Perhaps I should be more specific. One of the space projects most likely to be attacked and accomplished during the next months or years will be the launching of a lunar probe that will circle the moon and bring back, either through electronic relay or actual recovery, a series of pictures showing the surface features of the other side of the moon that so far have been hidden from the exploring eyes of man. This feat will probably be hailed as one of the most exciting and important results of space science. The newspapers and broadcasting media no doubt will present these pictures to the public under these captions, and we can't blame them for doing so. After all, such stories sell papers and soap. Looked upon with strictly scientific eyes, however, these pictures will have little value as intrinsic building blocks upon which further progress in science can rest.

There is an overwhelming probability that the other side of the moon will exhibit the very same selenological features as does the visible side. The probability is so great that it is practically a certainty, and no scientist in his right mind would spend a lot of money and effort in order to ascertain a certainty. Everyone can enumerate thousands of other scientific experiments that are infinitely more promising and profitable. Some might contend that these pictures will be of great importance because such a tremendously exciting and adventurous feat will show to the world what science of today can do. Others might say that these pictures will greatly appeal to the imagination of the public because exploring the hitherto hidden side of the moon is a perfect example of scientific ideals, namely, the exploration of the unknown. It might further be argued that there

is hardly a better opportunity than this for making the importance of science understood to the world public. I thoroughly disagree! On the contrary, these pictures will only add to the confusion of the public as to what science really is and what its aims are. We would be doing a disfavor to the public and to ourselves as scientists if we would present these pictures as a great scientific result while, in our hearts, we must admit that they are not. Scientifically these pictures will be highly interesting at best, but not really constructive for the future development of knowledge.

What will be of utter importance about these lunar pictures, however, will be the question: Who is going to bring them home first, we or the Russians! As a citizen of this country I want these pictures to be taken by us first, but as a scientist I admit to myself that these pictures will have a symbolic, rather than a true scientific significance.

IMPORTANCE OF EXPLORATION OF PLANETS

To a lesser but still striking degree, the same arguments hold for the exploration of the planets which now seems to be the number one project on almost everybody's priority list. Astronomers and astrophysicists from Galileo to Gerard Kuiper have amassed numerous data about the physical and chemical make-up of the alien worlds in our solar system so that we can say with a fair degree of probability that none of them is equipped to be of absolutely vital interest in terms of human affairs. In fact, the scientific and economic returns from a large-scale exploration of the planets at present cannot be expected to be compatible with the large sums of public money and scientific talent that would have to be spent on such ventures. Within the foreseeable future such projects could be justified primarily in terms of the international reputation of this country.

Of course, there is the strong argument that the most important scientific discoveries have been made by exploring the utterly unknown, and timid souls have always been accused of hampering the adventurous progress of science. Naturally, the history of science tells us that these truths are self-evident and they have not lost their intrinsic value. Yet, today, all these adventures and their honestly appraised prospective benefits must be weighed against the public funds and the national scientific talent that they require. Such appeals to the history of science miss one important point. In the past, tremendously important discoveries were made by indeed exploring the unknown, but such explorations were made at rather moderate expense. The equipment used by Faraday in his discovery of electromagnetic induction could be bought for a few shillings in every hardware store. It seems, however, that our forefathers have made all the cheap experiments and we are confronted with the expensive

ones. This is most certainly true with regard to planetary explorations.

There is only a moderate probability that an exploration of the solar system, through direct human contact, will produce scientific results that will profoundly enrich the volume of scientific knowledge with basically new ideas and truly change the course of scientific and human history. Our present knowledge about the physics and chemistry of the planets, while still meager, cannot be so drastically wrong. With the growth of science our chances of making the right predictions also have grown.

In terms of human affairs we can say that there are only two important bodies in the solar system, namely, the sun which serves as an agent of stability and as a source of energy, and the earth with its benign physics and chemistry. The other planets are the chemical dungheap of the solar system, and it is not likely that we shall find truly earth-shaking scientific novelties in the masses of noxious chemicals that constitute the outer shells of the planets. One could argue about the importance of studying the life forms that possibly exist on the planet Mars. Terrestrial biology could possibly make great strides through the results of a comparative study of terrestrial and Martian life forms. Yet, similar results can be expected by biological research right here on earth if given a fraction of the support required for an expedition to the planet Mars. I am not advocating that we leave the planets entirely alone in all the future, yet today I don't see sufficient scientific justification that would warrant the expenditure. Of course, if planetary explorations are vital to our country's international reputation, all scientific arguments become void and we are forced to visit Venus and Mars if only to show the world that we can do it, too.

All these problems must also be viewed with an eye to public science. Space exploration has fired the imagination of the public, and this fancy is constantly nourished by fantastic but nebulous promises of the space frontier. Yet the question remains if it is wise to keep the public excited about man's glorious future in space. If we promise the world a mountain of gold to be found on the planets, while we know in our hearts that, in all probability, we will be able to bring them only a bagful of carbon dioxide from Venus; if we do this, space science possibly could end in a tragic public disappointment.

Then, of course, there is the strong argument that space must be explored because "it is there." This argument is often advanced in the interest of public science, particularly with regard to the younger generation. There is nothing, so it is argued, that is better suited to appeal to the spirit of adventure and to the innate curiosity of young people than the "space frontier."

It is said that the exploration of space will cause many a young mind of today to pursue a scientific career, and it will do a great deal to make the next generation science-minded. No doubt there is a certain truth in this, yet there is also a question of morality and scientific integrity. Is it proper to fire the scientific imagination of young people by misrepresenting the true goals and ideals of science? True, it is simple to enthuse a young mind by telling him of a magnificent scientific future in which we shall explore the mysterious other worlds in the sky, colonize them and eventually conquer the galaxy. It is much more difficult to inspire young people with the importance of unravelling the mysteries of the chemical structure of chromosomes or with the task of harnessing the power of nuclear fusion. But it avails us little to take the easy way out. If we want to make honest scientists out of promising young people, we must be honest ourselves. We cannot give them a sense for scientific values if we fill their minds with fancy ideas of planetary colonization and interstellar explorations, while we ourselves know that for a long time to come such projects are, to say the least, utterly utopian. If we want to raise a generation of true scientists, we must give them a true picture of scientific ideals and of the seriousness of the scientific age. Above all, we must give them a true picture of the scientist so that they look upon us as mature and responsible people and not as interplanetary boy scouts that somehow failed to grow up. Only then can we change the devastating opinion that many of the younger generation hold of scientists as was evidenced by a recent poll taken by Purdue University. This poll involved a total of 25,000 twelve to fourteen-year-old school children across the nation. A number of statements were presented to which the children were given the choice to agree or disagree. One such statement was that all scientists are willing to sacrifice the welfare of mankind in the interest of their research. Almost one third of the children agreed! This is a frightening result.

Of course, there are many publications and statements that truthfully present the meaning and importance of the space age to the public. In its January 19, 1959 issue *Time* magazine quoted an unnamed "spaceman":

> We could concentrate entirely on our military developments and let the Russians have space to themselves. Would we thus make ourselves impregnable? No, because the rest of the world simply would not believe that we were impregnable. It would look to Russia as the clear leader—and the battle would be lost before it was fought.

This is an honest admission that does not invoke a nebulous scientific motive for our present space efforts. The President's Science Advisory Committee in the Office of Defense Mobili-

zation, under the chairmanship of Dr. James R. Killian recently published a pamphlet entitled "Introduction to Outer Space." The last chapter contains a few valuable sentences about the importance of the space age:

> Indeed, the scientific opportunities are so numerous and so inviting that scientists from many countries will certainly want to participate. Perhaps the International Geophysical Year will suggest a model for the international exploration of space in the years and decades to come. . . .
>
> Research in outer space affords new opportunities in science, but it does not diminish the importance of science on earth. Many of the secrets of the universe will be fathomed in laboratories on earth, and the progress of our science and technology and the welfare of the Nation require that our regular scientific programs go forward without loss of pace, in fact at an increased pace.

We must appreciate that these sober statements are not nearly as glamorous as the high-sounding but rather meaningless phrases about man's glorious future in space, but they most certainly make sense. These statements were written by our scientific colleagues and we most certainly subscribe to them. But we must not keep these truths to ourselves. It is very unfortunate indeed that the public and particularly our younger generation are given so little opportunity to learn about the worthwhile goals of space exploration. There are enough promising projects in the field of space science that lie outside the defense and propaganda domain. There are scientific projects that truly benefit all mankind such as communications relay satellites, the development of world-wide television networks, and above all, the study and eventual control of weather and climate. The challenging task of taming the unruly atmosphere of the earth cannot be solved without the tools of space science, and here is a task whose scientific justification is above question.

As we now enter the second decade of space medicine and watch the further development of the space sciences, it will be more than ever our obligation to be certain of our motives. Large sums of public money are available to strengthen our defenses and to uphold the reputation of our nation in the world. It is a job that must be done without compromising before the public the ideals of science and the acquisition of knowledge. As scientists we must be grateful that the present situation gives us a chance to conduct important investigations on a scale larger than ever before. But we must also realize that there lies a tremendous temptation in this present situation of the space sciences. Scientific research must be painstakingly honest not only in its execution and conclusions, but also in its motivation.

There is a great difference between science itself and its application to military hardware. Yet, through the recent his-

tory of atomic energy and space technology, science and its military applications have become hopelessly entwined in the mind of the public so that they are often regarded as one and the same. If this misconception is allowed to continue or even to grow, it will eventually destroy science. If the younger generation continues to regard us scientists as people devoid of responsibility for the welfare of mankind, they will burn us at the stake, like Giordano Bruno, but not because we have confessed to a scientific truth as we see it, but because we have corrupted the scientific ideals before the public.

In my efforts to spotlight the situation today, I would like to remind you of a perfect example of a scientist in the person of Archimedes, the famous Greek mathematician who lived in the third century B. C. As you will recall, Archimedes became most famous for his engineering genius which he applied to the defense of Syracuse. He was the first scientist in history who was called upon to serve his country during a war. He invented a most efficient catapult to shower the Roman armies that overran his home town under the general Marcellus. He constructed a levered grapple hook with which he lifted the Roman ships, dropped and shattered them; and he used a parabolic mirror and ignited their sails in the concentrated heat of the sun. In the fulfillment of his patriotic duties Archimedes lent his knowledge to the defense of his home town in times of war, but he never looked upon his ingenious military hardware as something worthy of the true spirit of science. Rather he saw in them, as he called it, "geometry at play." The Roman biographer Plutarch, who lived about 1,900 years ago, wrote about the admirable scientific attitude of Archimedes:

> He possessed so lofty a spirit, so profound a soul, and such a wealth of scientific knowledge that, although these inventions had won for him the renown of more than human sagacity, yet he would not consent to leave behind him any written work on such subjects; but, regarding as sordid and ignoble the business of mechanics and every sort of art which is directed to practical utility, he placed his whole affection and ambition in those purer speculations where there is no admixture of the vulgar needs of life; studies, the superiority of which to all others is unquestioned, and in which the only doubt can be whether the beauty and grandeur of the subject examined, or the precision and means of proof most deserve our admiration.

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Space Medicine of the Next Decade as Viewed by an Environmental Physicist

KONRAD J. K. BUETTNER, *Ph. D.*

I AM thankful to General Otis Benson for the opportunity to be present at this celebration. It is like a class reunion with our beloved headmaster, Harry G. Armstrong, who founded the department of space medicine. The opportunity to visit the working laboratories of the School of Aviation Medicine today convinced me that many research items I wanted to propose are already under consideration. In addition, I would like to comment on the previous remarks made by my friend Heinz Haber. My comments are from a recent speech to a group of professors at the University of Washington on the question, "Why space flight?"

Obviously, discussion of the environment of a future space man would be futile if we knew there never would be one. Manned space flight, however, will be based on a great number of unmanned space flights. Any planning, then, involves the motive for space flight and its possible resources. Whether we like it or not, the first space vehicles came from military establishments. Space has become a military proving ground, and, as Haber has shown, it also became a proving ground for propaganda.

Since the invention of modern mass fabrication in the early twenties, our economy and world economy have suffered from depressions, except during the preparation for war or during wars. I do not know how economists explain this odd fact. This leads to the necessity for an energy sink. Energy sinks in antiquity were, besides wars, the pyramids in Egypt and Mexico, and the Gothic cathedrals, so we might as well use space flight instead, to keep the use of science peaceful.

Throughout history energy sinks have usually not been seen in their true nature by contemporaries. It seems as though expenditures beyond a certain amount are just beyond comprehension and are, therefore, trusted to proper authorities, without public debate. This is the content of the third law of Parkinson.[1] Education of the whole population in natural sciences would be necessary before this acceptance by default could be altered.

To the scientist, space flight might be a dream ship offered to him for his perusal, and in science is, of course, where the real

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progress might and certainly should be. In meteorology, for instance, we are in the position of an engineer who knows the temperature and the motion of an engine, but not its fuel input or its energy balance. This lack of data could be amended by measuring incoming and outgoing radiation from the outside. The next Vanguard is to try to do this.

Following this digression on motivation, a historical remark seems in order. What General Armstrong founded 10 years ago was certainly the first department of its kind in the western world, but was it really the first organization of its kind? I learned through unconfirmed press reports in 1950 about Russian tests with V-2's carrying animals in warheads returning safely by parachute. My urgent plea, at that time, to bring the man who reported the story, into this country, was left unanswered. In the meantime a Russian scientist[2] has confirmed that these animal tests were started in 1949.

My present task is to predict the state of the art ten years hence with respect to man's environment in space flight. This environment will be a capsule protecting him from outer atmosphere or the lack of it, cosmic missiles and rays, and heat and cold, and providing him with a frame to cope with high G and no G. Besides providing food, water, air, and waste disposal, the capsule has to function as an observatory, as a communication center and, probably, as a control center for the ship.

At present the following environs warrant discussion: balloons; rocket-glider planes of the German type A 9/10 or American X-15; satellites around the earth and the moon; lunar surface after landing. Planetary landing and solar satellites are omitted here. Table 1 shows some basic facts for the different stages. All these environs lack an outer atmosphere. Most of them are in the wake of cosmic ray primaries; some may touch the Van Allen belt of strong ionization. There is another part of space flight: This is the waiting time before the actual shooting. I have observed in both the German Air Force and the U. S. Air Force that crews are often left in extremely hot or extremely cold weather for quite long periods before take-off.

Instead of a full consideration of the many environmental problems, I shall restrict my discussion to a few specific items that warrant special attention.

TEMPERATURES

Except for those parts of its journey while leaving and reentering the earth's atmosphere, the hull will attain a temperature in equilibrium with the possible inner heat sources, the solar radiation, and the low-temperature radiation from the earth, the moon, and cosmos. This holds, mainly, also for a lunar base

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TABLE 1. *Some environmental characteristics of space craft or celestial area occupied*

Craft or area occupied	Main phases or types of flight	Duration of flight or phase	G force expected	Temperature*	Primary radiation	Meteors
Balloon	Ascent/descent	Days	1	RE	Present	Absent
X15	Ascent	Minutes	10	Warm	Absent	Absent
	Free float in space	Hours	0	RE	Present	Present
	Re-entry to earth	Hours	2	Very hot	Absent	Absent
Satellite	Ascent	Minutes	10	Warm	Absent	Absent
	Free float in space	Unknown	0	RE	Present	Present
	Re-entry to earth	Hours	2	Very hot	Absent	Absent
Moon base	Ascent	Minutes	10	Warm	Absent	Absent
	Free float in space	Days	0	RE	Present	Present
	Lunar landing	Minutes	1	RE	Present	Present
	Lunar stay**	Unknown	0.2	RE	Present	Present
	Lunar start	Minutes	1	RE	Present	Present
	Re-entry to earth	Hours	2	Very hot	Absent	Absent

*RE=radiation equilibrium.
**Possible ionizing radiation.

if it is not buried deeply. Radiation equilibrium temperatures were discussed during the space symposium in San Antonio[3] in 1951. Strangely, these data were unknown to the scientists who made the surfaces of the Explorer and the Vanguard.[4, 5] The electronic equipment needed to be protected only within the range -5°C to +45°C. With a better white paint, a more constant temperature can be achieved. "Active" control should not be requested until all the rather inexpensive "passive" means are exhausted. These controls require certain shape factors and paints. Figure 1 shows the reflectivity of white paint and of aluminum for various emitter temperatures. A constant temperature can best be achieved by white paint.[3] According to recent press reports, the Russians achieved a satisfactory surface temperature of their space ships of +10°C.

The partial differential equation of heat conduction $\frac{\partial}{\partial t}(\rho c T) = \nabla \cdot (\lambda \nabla T)$ (T=temperature, t=time, ρ=density, c=spec. heat, and λ=heat conductivity; ∇=spatial gradient or divergence) has a bewildering number of solutions in space and time. Surfaces hit by constant heat flow warm up proportional to $\lambda\rho c$. Heat waves in a medium move proportional to $\lambda/\rho c$. The final breakthrough of a heat wave through a thick slab of insulator comes quite suddenly; a small change of the slab thickness might mean the difference between a harmless warming and a catastrophe.[6]

Convective heat transfer between the skin and the wall is either "forced" or "free" (produced by density differences). The latter follows the G-forces. It would increase the wall to skin transfer of heat during ascent and during the return ellipse. It is tempting to assume that there will be air-free insulators in the hull of the space ship. This assumption helps, however, only where insulation is not very important; to wit, in space. Even at small air pressures, heat transfer through pores is reduced

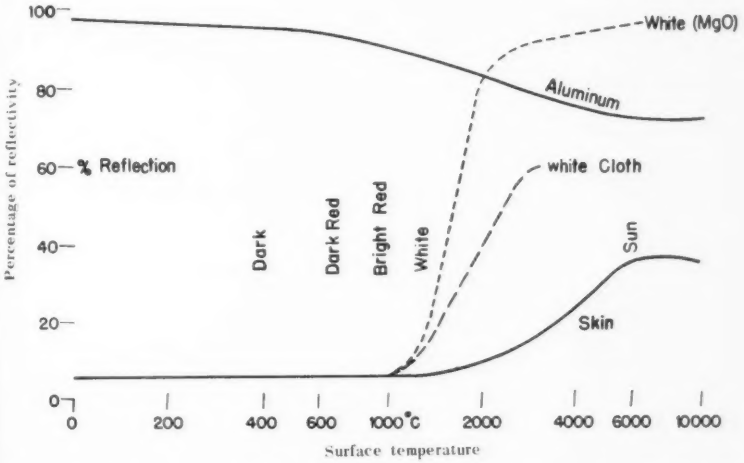

Figure 1. Reflectivity of different surfaces for the radiation from black body radiators of different emitter temperature. Data indicate the color observed by the eye and the temperature of the sun.

only if molecular free paths exceed the pores' width; but even then a substantial radiant heat-flow bridges the gaps. While at Wright-Patterson Air Force Base in 1947, I "invented" a metal covering of the pore or fiber surface to block this transfer. A metal layer 50 mμ thick suffices. I learned, then, that four patents were issued or were pending on devices to do just that. None of them has been seen on the market.

One of our environs is the lunar surface. While at the School of Aviation Medicine I asked Dr. Lettau[7] for help in order to evaluate the old Mt. Wilson thermocouple data during lunar eclipses. Using elaborate mathematical technics, he found a surface layer of low density and conductivity about 60 cm. deep, but below this he found high conductivity. The superficial matter resembles face powder *in vacuo*, while the deeper strata seem to be rock. This holds for mountains as well as for maria.[8] I explained the "dustiness" by action of cosmic ray primaries,

which penetrate to about the same level. This theory has in the meantime been used by Gerard P. Kuiper, probably without knowledge of its publication in the 1951 space symposium and elsewhere.[3,8]

Disregarding Lettau's and my data, Gold[9] claims that the maria are filled to a great depth with dust. Recent Mt. Palomar photographs[10] show distinct features all through the maria, thus throwing doubt on Gold's theory and verifying ours. The lunar dust might be cemented together by vacuum effect, as shown by North American Aviation. It might, therefore, make excellent, sturdy, light weight, insulating building material. Houses could be made airtight by plastic sheets on the inside.

Exposed parts of landed space craft and a moon house should have essentially the radiation equilibrium temperature. As stated before, the moon surface is not crushed because it suffers extreme temperature variations, but its temperatures vary so much because it is crushed. By digging down a meter or more, one has direct contact with solid rock which has a constant temperature around 0°C. Temperature control then should be easy.

Man will be at the receiving end of the long chain of heat flows in a space craft. He might be exposed to certain risks. It is useless to say that he can tolerate or not tolerate a certain temperature without specifying the exposure time. Many different laws control this effector versus time correlation. Tolerance to extreme hot air is restricted by the reaching of extreme skin temperature for a certain time, a condition which then leads to the chemical denaturation of skin protein, commonly called a burn. This chemical effect is strictly a rate process, and depends on temperature and time. Exposure to air at about 100°C attacks primarily the circulatory system, and the limiting factors are the heart beat, increasing core temperature, and sweat load. Again only the combination of temperature and time defines bearability. Actual breakdown in these exposures can be dramatic (fig. 2); extrapolation is difficult in view of the *circuli vitiosi* which start at a certain point.

At longer exposures to even lower temperatures, breaking points also are reported. The National Park Service learned that it is unwise to leave the guards in Death Valley proper during the summer months; this finding gives us another time-temperature relationship.

The environmental temperature conditions bearable for normal men clothed or exposed are given in figure 3.

RAYS AND PARTICLES

Meteors have not yet harmed an existing space craft, with one possible exception. This fact should not make us overcon-

fident. We are free of known meteor showers only about two thirds of the time, especially in February, March, and September. The

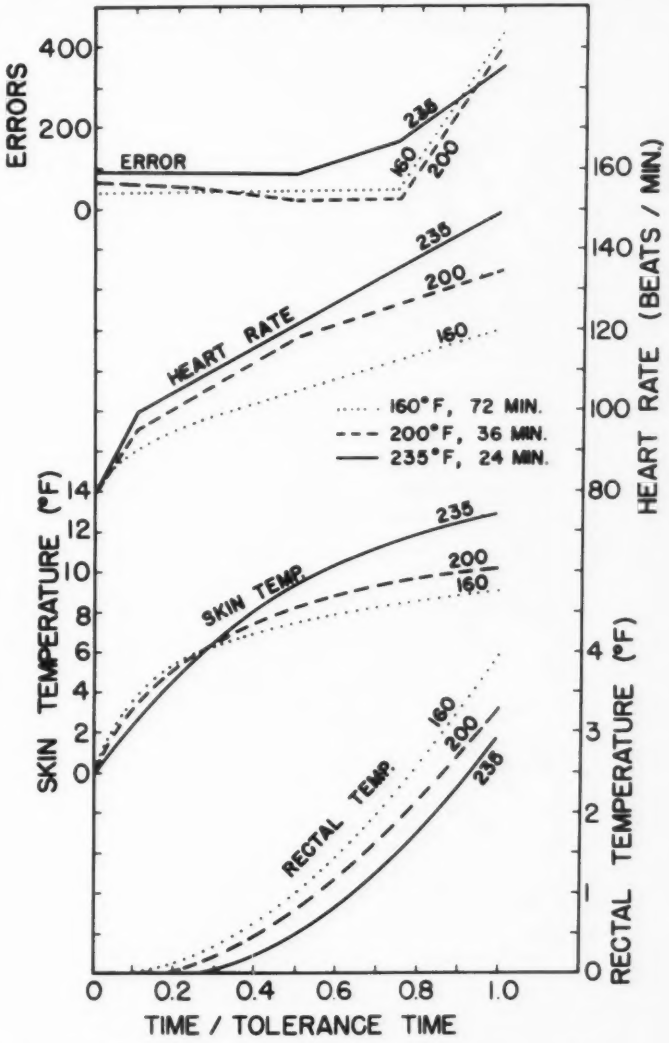

Figure 2. Human response to heat exposure. Upper curve shows errors in Link Trainer. Based on experiments at the University of California at Los Angeles by Blockley and Lyman.[11] *(From Buettner.*[12]*)*

silencing of both radio transmitters of 1958 gamma is believed to be caused by meteors of the Aquarids shower.[14]

Outside the aeropause, space craft are exposed to a multitude of radiations and cosmic missiles. Of these, photons seem harmless except for possible x-rays produced, by solar electrons, on the space craft hull or on the moon.

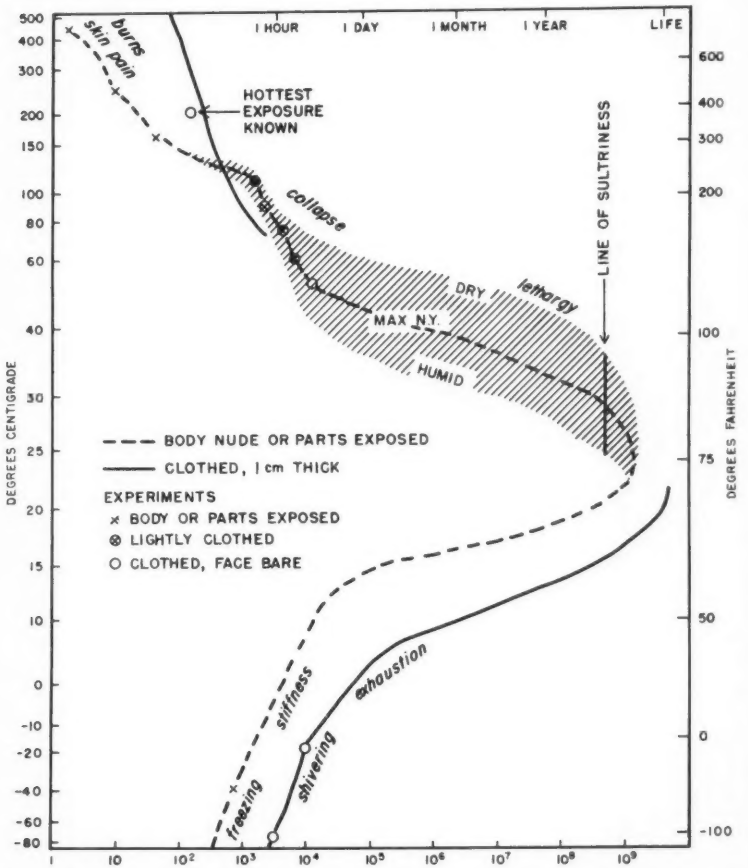

Figure 3. Safe heat and cold exposure times in seconds for healthy, normal men at rest with body wholly or partly exposed. Room is free from artificial ventilation and radiation; air and wall have identical temperature. Humidity influence is shown by hatching. Max. N. Y. = highest data of temperature and humidity in New York City. (After Buettner.[13])

The spectrum of solar and cosmic ionizing particles runs from aurora producing protons of 10^6 eV to cosmic ray primaries exceeding 10^{18} eV or 0.1 cal. Lower levels of the exosphere are considered safe from the standpoint of possibly accumulated r units. Specific effects from the impact of heavy cosmic primaries, however, have been observed.

The deadly Van Allen belt seems restricted to the exosphere beyond 6,000 km. in height and to lower latitudes. The most dangerous or hard belt is believed to consist of cosmic ray tertiaries—probably protons—coiled around lines of the earth magnetic field. This field is assumed to be invariant, which seems rather doubtful. Field variations might well change the hard belt.

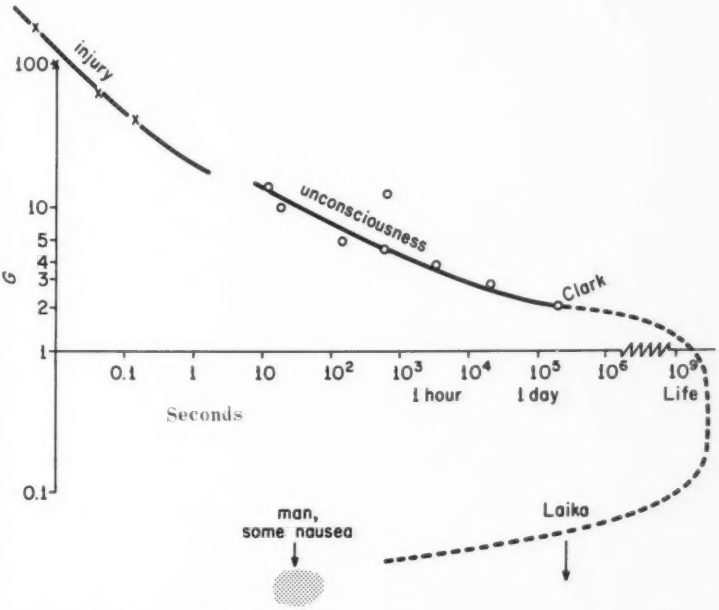

Figure 4. Safe G exposure times of man plotted in seconds. Dotted line is highly hypothetical. (Data for near zero G refer to the dog in Sputnik III and to experiments of Gerathewohl.[17])

They would imbalance stable particle trajectories; this usually would result in their loss. Consequently, this belt will have minimum strength during maximum magnetic fluctuations; but the belt has been discovered exactly at that time. If this hypothesis is correct, a stronger and more expanded ring is to be expected during a sun spot minimum.

The moon's permanent cosmic ray bombardment continually produces neutrons which produce new isotopes. This seems to be the reason why Kuiper claims strong radioactivity. This question of lunar radioactivity should be investigated more thoroughly. On the one hand it is not easy to see why, in a billion years, there should not be an equilibrium between the incoming cosmic primaries and the induced radioactivity of the surface matter. Meteors so far have not shown much induced radioactivity; but

the question is certainly not settled. On the other hand, the radioactive surface layer, if any, would probably coincide with the surface dust layer and it might be an easy task to clear this very lightweight matter from a large surface area.

G-FORCES

Human tests with near zero G of short duration show no alarming reactions in man. On the other hand proposals of creating artificial G by spinning the space ship run into dangerous Coriolis forces. Animal data for long-time zero G also are reassuring. But all these tests contribute nothing to the nightmares which plagued us 10 years ago such as H. Haber's[15] problem of no sleep because of fear of falling, Lindenberg's[16] statement about the hydrostatic pressure exerted by the upper part of the brain on the lower, and my hint that at zero G the weightless masses in an inflamed intestine will be in the center of the "tube," insulated by foam from the tube walls. There probably will be no answer to these questions until man stays long enough where G=0.

Figure 4 shows G tolerances on the same kind of scale as figure 3.

AIR AND WATER

Oxygen partial pressures above and below certain limits endanger life; we find again a certain time versus effector relationship (fig. 5). Any carbon dioxide conversion into oxygen has, in the long run, to adapt its respiratory quotient to that of our lungs.

Man in a space capsule rebreathes all gases and vapors around him that are not exchanged from containers or by chemical processes. Oxygen, carbon dioxide, and water will and can be controlled. Valuable work has been done by submarine scientists on the possible accumulation of other gases, such as CO, radon, and its isotopes, and body gases. All problems seem solvable, many are solved. Ion space charge in air is held responsible for many unexplained environmental effects on man. Work on this aspect is in progress in many places.

The water cycle in an advanced space ship will be about as manifold as in nature. The algae will compound some water into starch. Condensation or deposition (direct transfer vapor to ice) occurs on certain walls cooled through low temperature radiation into cosmos. Man ingests water in drink or food, losing it partly in urine and feces, partly through skin and lungs.

The skin water transfer is now much better understood. Of the secreted sweat and of water or solutions at less than 2 molar on the skin, portions flow back by diffusion.[18-20] This osmotic diffusion is effected by an active process going on somewhere in the subskin. It is restricted by the stratum corneum conjunctum,

a keratin-like layer only 5 to 10 microns thick. This layer is the only protective barrier our body has against all chemical, bacterial, and other transfers.

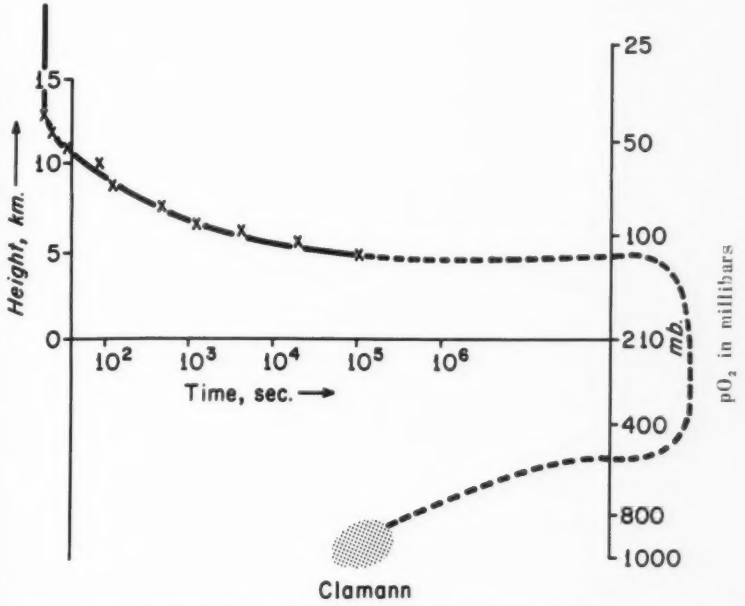

Figure 5. Safe oxygen exposure times of man. Ordinate: 0_2 - partial pressures in millibars (right), height in km (left). Dotted line is highly hypothetical.

The curves in figures 3 through 5 do not report new results but propose a new way of listing data. This method might help to map the vast array of strange environs to be met by space pilots in the years to come.

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Space Medicine of the Next Decade as Viewed by the Engineer

FRITZ HABER, *Dr. Ing.*

AT this celebration of the tenth anniversary of the Department of Space Medicine, School of Aviation Medicine, Randolph Field, the titles of the papers presented reflect quite aptly the various fields of science that are working together in order to make space flight a success. The department of space medicine originally consisted of representatives of those sciences. If we investigate today the groups, associations, agencies, and industrial companies that make up the team working on space flight, we see a similar representation. Space flight really encompasses all fields, and not one company or government agency alone is able to carry out the necessary work without asking for help from other fields.

The title of my paper is not a paradox, therefore, when it combines two sciences which apparently have nothing to do with each other, that is, medicine and engineering. Such a combination is not a strange phenomenon as far as space flight is concerned. In this presentation I would like to discuss some

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of the correlations that exist between the two fields. I would like to show how requirements of one field impose restrictions on the other and how advancements of the state of the art of the one field simultaneously permit the widening of aspects in the other.

The title further implies that space medical problems and their relation to engineering in the next decade should be discussed. It is, of course, always difficult to make predictions. Now, if one doesn't know how to predict something, it is always easy to extrapolate or observe the trend of events during the past and project this same trend into the future. Therefore, instead of making a prediction, I would like to make some extrapolations. I believe I should give you an example of what I mean with this extrapolation.

About 20 years ago it was a major accomplishment to fly at altitudes of about 40,000 feet. At that time aviation medicine was very much concerned with keeping a man alive at such altitudes where oxygen is not as plentiful as at sea level. Scientists were studying the associated physiologic phenomena in order to learn as much as possible of what happens to man under conditions of oxygen deficiency. New equipment had to be devised to enable man to live safely at such altitudes. Later oxygen equipment and pressurized cabins were perfected so that in the decade 1940 to 1950 flights at about 20,000 feet became routine first in military and later in commercial operations. In the present decade, military operations at 40,000 feet became commonplace and those altitudes are now becoming the airways for commercial aviation. What was a major accomplishment 20 years ago is now something that anyone can do by flying in a commercial jet airliner from New York to Paris at 40,000 feet.

What is the essence of this example? It shows two things: First, we see how a major feat of yesterday becomes a routine today. It is not difficult to predict that similar things will happen in the area of space flight. The example also is significant in another way. It certainly shows how the perfection of the state of the art eventually removed all restrictions and limitations that existed in this area. The problems of aviation medicine 20 years ago hardly exist today because the final engineering of the technical article practically removed the basis for the existence of the problem. The problems of 20 years ago were primarily associated with the then-existing technology.

Space flight today is comparable to the early history of aviation. Simply look at the crude way in which we attempt to accomplish space flight in order to see this point. Very soon we will put a fellow into a cramped little capsule, shoot

him into the sky with tremendous force, let him fly helplessly around the earth, then on his return we let him collide with the atmosphere where, again, he is subjected to tremendous forces together with roasting temperatures. Finally, we drop him at a landing spot whose selection is only under very little or no control. At present this is the best we can do. The state of the art is just about far enough advanced so that we can risk sending a man into space. It is obvious that we have to do much better if we want to make such flights a daily routine.

Now, coming back to predictions and extrapolations, I believe it is safe to say that space flight, space medicine, and its associated problems will go through similar phases of development as did aviation and aviation medicine. Many of the space medical problems we are fighting today result from today's technology. The advances of the state of the art may alleviate many of those problems and will make space flight as similarly routine as the flights today at 40,000 feet and at almost sonic speeds from New York to Paris. It not only is likely but practically certain that one of us in this audience will go out into space without meeting the rigid medical requirements that must be met today in the selection of a space pilot. I do not know, of course, if it will happen in the next decade, but it is certain that steps in this direction will be taken.

May I emphasize that I do not wish to imply that engineers are the ones who will solve all medical problems. They just do not roll up their sleeves, design a better gadget, and tell the medical man to go home. Just as aviation medicine has made excellent contributions to the general science of flight and has set goals for the engineer, in the same way space medicine is a vital factor, not only today but also in the future. The engineer will always look to his space medicine teammate for understanding of the human problem and for guidance as to human limitations.

SPACE MEDICINE PROBLEMS AND THE ENGINEERING ART

So far I have discussed generalities. Now I would like to introduce a few areas where I can illustrate the correlation between the state of the engineering art and space medicine problems. I want to explain with a few simple examples why we have the medical problem today and what must be done to alleviate or even remove it.

Take, for instance, the acceleration during launching which, for an orbital vehicle, is approaching the human tolerance. It is quite useful to consider the reasons for the high acceleration we employ today and then consider the possibility of reducing these accelerations to a level that is tolerable for a more average person rather than for a specifically selected man.

It is common knowledge that today's rockets are burning fuel at a tremendous rate. To bring a satellite into orbit, a major portion of the weight of the entire rocket on the launching pad is composed of fuel. It is obvious that to raise a rocket from the launching pad, the thrust must be greater than the weight. Let's assume for the purpose of this discussion that we have a rocket weighing 100 tons and that the thrust exceeds this weight by 50 per cent. The thrust is then 150 tons. This is another way of saying that the initial acceleration is 1.5 G's.

If it were possible to design a single-stage rocket to put the satellite into orbit, then approximately 95 per cent of the take-off weight would be fuel; that is, 95 tons. This means, of course, that at burn-out, after all the fuel has been consumed, the final weight that remains is only 5 per cent of the initial weight, or 5 tons. Since, however, the thrust of the rocket engine is undiminished and remains at 150 tons, we now have a tremendous acceleration. A force of 150 tons is now propelling a mass weighing only 5 tons, resulting in an acceleration of 30 G's. The tremendous fuel consumption reduces the total weight so drastically that we finally obtain those high accelerations. You can see clearly the correlation between the engineering fact of fuel consumption and the medical fact of the acceleration imposed on the man in the vehicle.

Technic of staging. Quite fortunately for the poor prospective pilot, it is almost impossible to build a rocket that has an empty weight of only 5 per cent of the total weight. It is very difficult to obtain such light structures and rocket engines. The engineers, therefore, long ago developed a trick known as "staging" that permits higher structural weight percentages. This technic is based on the fact that the entire structure does not have to be lifted into orbit but that parts of it are jettisoned at lower altitudes and velocities. In this way relatively more structural weight and payload is permissible on the launching pad and of course remains at burn-out of each stage. Consequently, the very high accelerations are not obtained. This is now a case where the shortcomings of technology are helpful to the human factors.

Figure 1 shows the reduction in peak acceleration because of staging. It shows how drastically the peak is reduced if two stages are used instead of one and how further reduction can be achieved by going to three stages. It is obvious, of course, that the duration of the acceleration is increased by the use of multiple-stage rockets because the time integral of acceleration must be the same in order to obtain orbital velocity.

As pointed out before, today's rockets are burning fuel in large amounts, and it has been shown how fuel consumption during the flight reduces total weight, thereby increasing the

acceleration. This is the present state of the art. The reason for this high fuel consumption is the limited velocity of the exhaust gases. If it were possible to increase this velocity, the same amount of thrust could be achieved with a lower mass flow of combustion products since, in accordance with Newton's

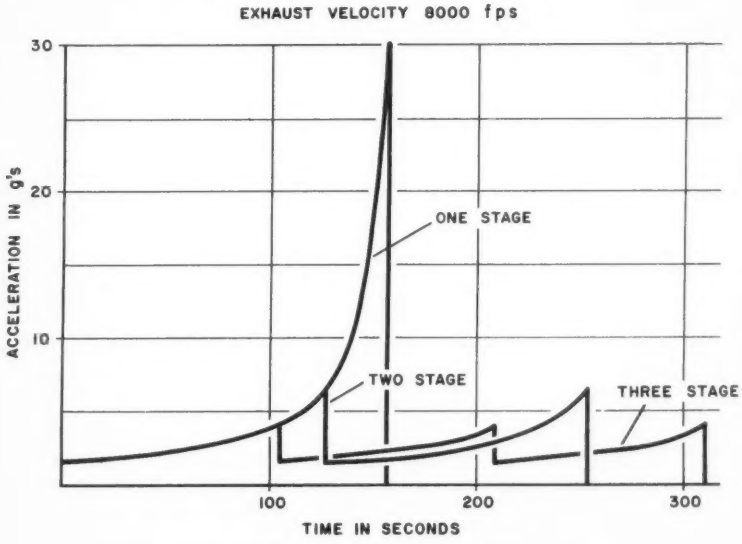

Figure 1. Acceleration during launch.

laws, the thrust is the product of mass flow times velocity. We can trade higher velocity against smaller mass flow for the same thrust. In this way a rocket engine with a lower total fuel consumption would be obtained with the associated smaller amount of total fuel.

Now it immediately becomes clear that we could build a rocket that is, let's say, composed only of 50 per cent fuel rather than 95 per cent, as above. If we again had an initial acceleration of 1.5, the acceleration at burn-out would go to only 3 G's. This would require an exhaust velocity of about 30,000 feet per second.

To show this in more detail, we turn to figure 2 which depicts the reduction in peak acceleration with increased exhaust velocity. Today, exhaust velocities of approximately 8,000 to 10,000 feet per second are possible which, depending on the number of stages, produce peak accelerations up to 30 G's. Substantial reduction in this acceleration peak can be obtained with an increase in exhaust velocity. Staging decreases the acceleration peak even more. Therefore, success in achieving higher exhaust velocities will benefit the space pilot.

Another way of making accelerations more tolerable for man would be to control the thrust of a rocket engine in such a manner that the thrust diminishes in proportion to the decreasing weight as the fuel is consumed. Rocket engines today, although perfected to quite a degree, are still rather crude. The process of providing thrust from such a device constitutes a barely contained explosion in a suitably formed compartment. Things become more difficult if attempts are made to control or throttle

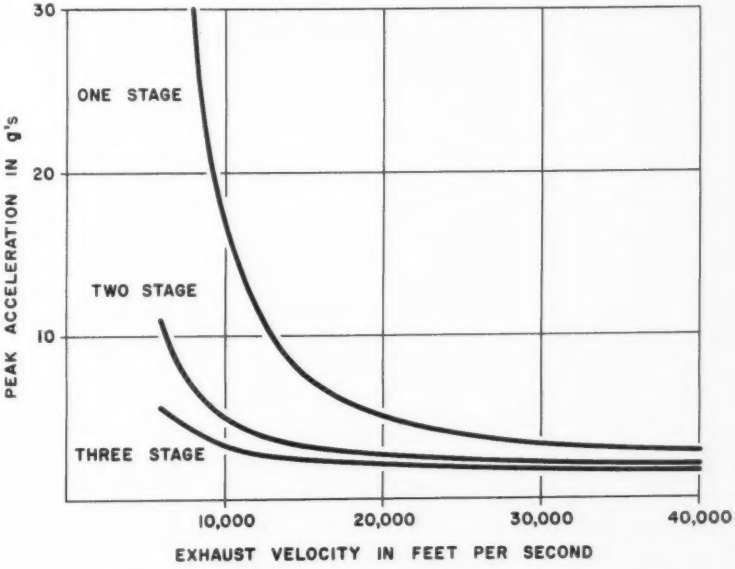

Figure 2. Peak acceleration as function of exhaust velocity.

the thrust. First attempts were made in this direction for the rocket engine of the X-15. Similar procedures may be applied to large rocket engines not only to control thrust but to control acceleration and flight path as well.

Low weight factor. Everyone associated with rocket engineering and space flight is aware that the low weight factor of all rocket devices is of utmost importance. If we plan today to put a man into orbit, all the equipment necessary to sustain the man's life must be as light as possible. Excessive weights are out of the question. This, of course, imposes severe restrictions on all equipment. If it were possible to relax these restrictions, life for the man in the orbital vehicle could be made much easier.

As pointed out previously, most of the rocket's total weight constitutes fuel. In figure 3 it is shown how the weight distri-

bution depends on exhaust velocity. This figure shows the weight distribution for a single-stage orbital vehicle, and it clearly indicates how much more structure and payload could be installed if the exhaust velocity could be made higher. Today with exhaust velocities in the order of 8,000 to 10,000 feet per second, only a small percentage of the total weight can be made available for payload and structure, while at higher exhaust velocities this percentage increases rapidly.

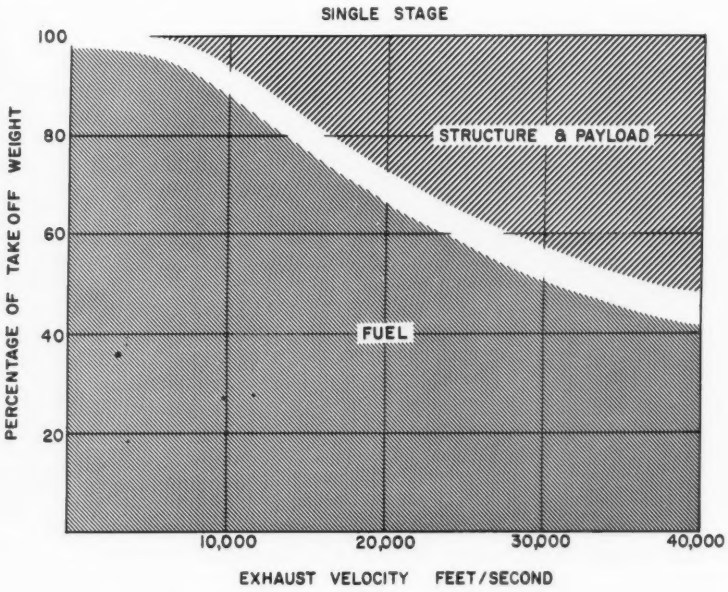

Figure 3. Weight distribution of orbital vehicle.

Again, staging helps significantly in this respect; this can be seen from figure 4 which shows the weight distribution for multi-stage rockets. It is evident that today only staging grants us enough weight allowance for payload and structure to make space flight possible. Increases in exhaust velocity would substantially improve the situation.

It should be noted that staging is a necessary evil. It certainly does not improve the reliability of the vehicle, as past experience has shown. It is quite clear that a single-stage rocket is much simpler because nothing can be wrong with the gadgets which are not there. For the time being, however, we have to live with multi-stage rockets.

It is beyond the scope of this paper to make predictions as to when such increase in exhaust velocity may be achieved.

The chemical-fuel rockets with the presently known fuels already make the best use of the available energy. Significant increases in exhaust velocity with such fuels are not very likely. Other means of accelerating the propellant gases are being studied. Some promise appears to come from a new field which is called "magnetohydrodynamics." The applications of this new field of science are fairly new and are being applied quite effectively. The behavior of gases is studied under conditions of very high temperatures where, through ionization, gases become electric conductors. A gas in a magnetic field behaves then exactly like any other current-carrying conductor

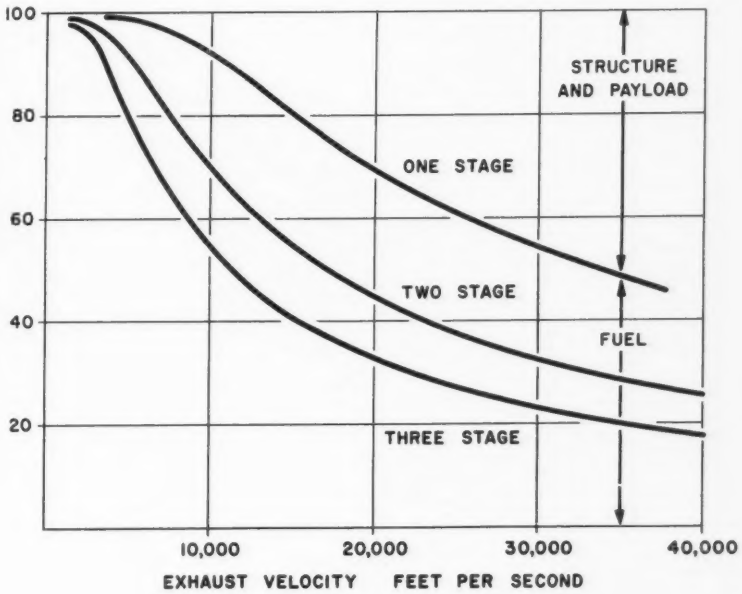

Figure 4. Weight distribution of orbital vehicles.

as, for instance, a wire in an electirc motor. It is possible then to accelerate the gas through magnetic forces. It is still too early to say how much improvement really can be expected from this field. It is interesting to note that this new field has strong relations to astrophysics where magnetohydrodynamic forces have been known for quite some time as major forces acting in the universe.

The problems discussed so far were all concerned with the launching of the vehicle. A solution to those problems appears rather simple. In contrast, the problems of re-entry are formidable.

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Re-entry of satellites. Everyone knows that most of the satellites placed in orbit have met a fiery death when they finally returned into the atmosphere. Aerodynamic heating and tremendous forces destroyed the satellite vehicles as they came in contact with the atmosphere again. How can we expect to safely bring a man back to earth from a satellite orbit?

Despite these difficulties, I believe that we will see exactly such a feat accomplished in the next decade. An enormous amount of engineering work has gone into investigating the problems associated with re-entry, and the general subject is fairly well understood. It is evident that the tremendous kinetic energy which the satellite has relative to the earth must be dissipated in some fashion in order to reduce the velocity gradually. The energy put into the satellite during launching with so much effort is now a major source of trouble and must be dissipated. Each pound orbiting around the earth has an energy of about 4 kilowatt hours (kw-h) or approximately 13,000 British thermal units (btu). You will appreciate the significance of this amount of energy if you consider that less than 10 per cent of this energy is enough to bring the temperature of a re-entering pound of steel not only to the melting point but to the boiling point.

This great energy brings two major problems in the re-entry phase. One is again the problem of high forces of inertia, this time due to deceleration. The other is the problem of high temperatures. In this area engineer and space flight surgeon have to work closely together because all parameters are so critical that only the slimmest margin exists.

Deceleration. To illustrate this, let's first discuss the problem of deceleration. All the schemes proposed so far utilize a simple shape for the re-entry vehicle which is slowed down by air drag only. The control of the trajectory is very critical. The initial flight path angle, relative to the horizontal, especially can make a tremendous difference to the peak deceleration that occurs during re-entry.

This is shown in figure 5 depicting the peak decelerations as a function of this angle. It can be seen that the deceleration peak increases sharply with increasing initial angle and soon trespasses human tolerances. It is evident that quite an elaborate guidance system is required during launching to establish an orbit within certain tolerances so that the entry angle does not produce too much deceleration at the eventual re-entry. None of the American or Russian satellite orbits have been accurate enough to meet these requirements. Also, for a controlled re-entry some system is required to ascertain proper re-entry conditions. As you can see, there is a very

definite correlation between human tolerance and engineering requirements, and it is obvious that this correlation is very critical.

Figure 5 indicated that the acceleration peak is minimized if the initial angle is close to 0 degrees. Still this peak is in the neighborhood of 8 G's. The question now arises: What can be done to minimize this deceleration even further to make it more tolerable for the average human being? So far we have discussed re-entry using aerodynamic braking by drag only.

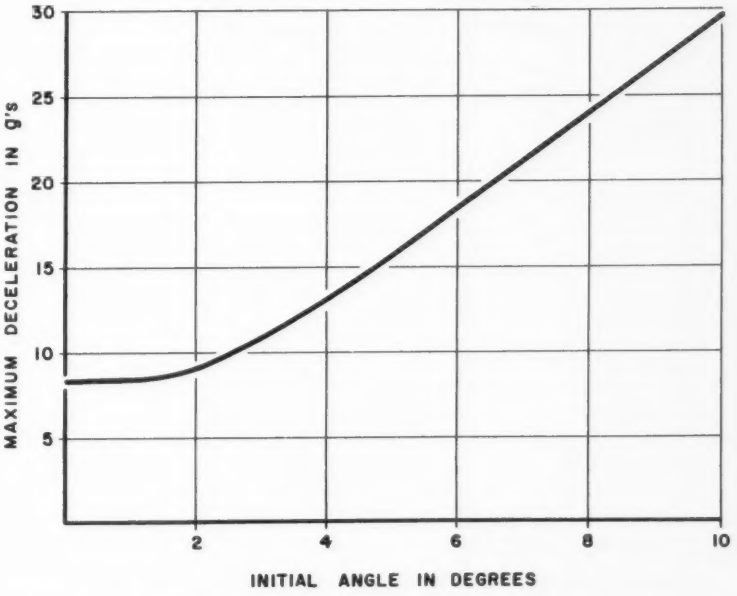

Figure 5. Maximum deceleration as function of initial angle. (After Chapman[1])

Wouldn't it be sensible to try to apply aerodynamic lift as well? Lift could be used to prevent the satellite from losing altitude too rapidly after the initial braking has taken place. In this way, the trajectory could be maintained at high altitudes with a resultant decrease in the peak deceleration.

Figure 6 shows the reduction of peak deceleration if lift is applied. The curve is plotted using the lift/drag ratio as parameter. It can be seen that for a lift/drag ratio equal to 0, we again obtain about 8 G's for the peak deceleration. Lift/drag ratio of 0, of course, constitutes a pure drag vehicle without any lift. As the lift is made larger, substantial reduction in deceleration can be achieved. As in the case of launching, of course, the duration of deceleration is increased since,

again, the time integral of the deceleration must be equal to the orbital velocity. This picture looks quite tempting if we look only at the reduction in peak deceleration. It is obvious that a space medicine man would like the engineer to employ lift in order to get better conditions for the pilot. This appears especially desirable as a lifting device also could provide some control in the later phases of the re-entry and possibly permit selection of a suitable landing spot.

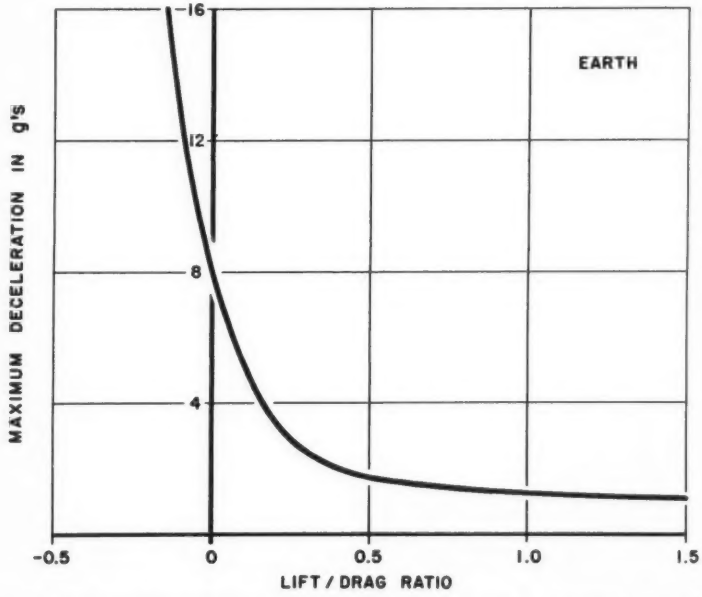

Figure 6. Maximum deceleration as function of lift/drag ratio. (After Chapman[1])

High temperatures. There is, however, another side to this picture. The problem I am referring to now is the heating problem. The employment of lift can have an influence in this area. We have seen that the kinetic energy, if totally converted into heat and transfered to the vehicle, can melt and vaporize any orbital vehicle. Quite fortunately the total kinetic energy is not transferred to the body as heat. A significant fraction remains in the air as heat and turbulent motion. It is now necessary to minimize, by choice of proper design, that part of energy which is transfered to the vehicle. Two extreme cases are useful to consider.

The first example employs a very light structure with a negligible capacity for heat storage. This design will heat

up very quickly and has to rely on heat radiation to dissipate the energy. The second case is represented by a structure with a large capacity for heat. This design eliminates heat by letting the structure's surface gradually melt away or storing the heat in a so-called "heat sink" which is jettisoned after the heating peak is passed.

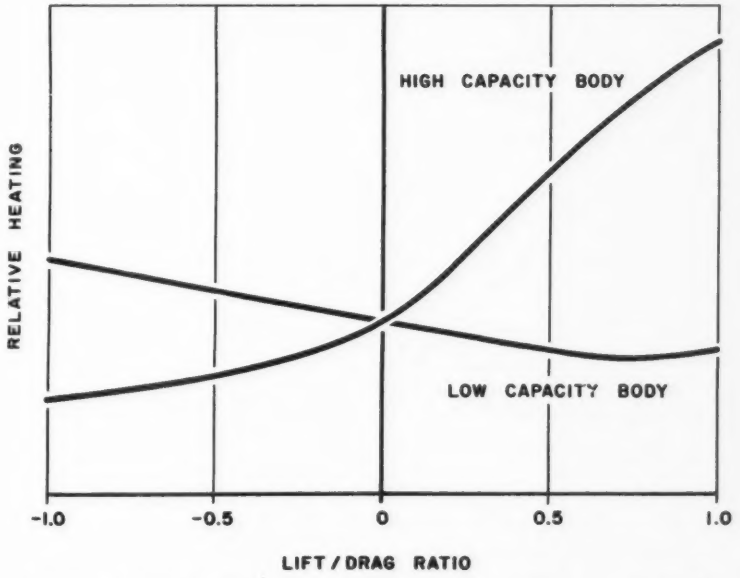

Figure 7. Heating of bodies with different heat capacity. (After Chapman[1])

The two cases require different re-entry conditions for minimum temperatures. Let us assume that we could design a a vehicle of either kind in such a way that both attain a certain temperatures without the use of lift. As we employ lift we will obtain different temperatures. Figure 7 indicates the variation of temperature we can expect as we add lift to our vehicle. We can see that the first case, that is, the low capacity structure benefits by using lift, whereas the high-capacity structure is adversely affected. Lift may be harmful or useful, depending on the type of structure. Therefore, our aforementioned desire to use lift in order to reduce the deceleration must now be checked in view of the heating problem. Careful studies have to be made in order to arrive at the optimum solution.

Presently a nonlifting vehicle appears as the simplest solution. The first manned satellite, therefore, will be of this type. In the future the engineer again may be able to oblige his space medical colleague by reducing the high decelerations

with the help of a lift of some kind. Again magnetohydrodynamics may play a role in providing this lift.

Manned satellites. During the next decade certainly we will see a manned satellite. It can be assumed, too, that after the first adventurous undertaking such events will become more routine because of further progress. At first these flights will last for a relatively short time of a few days. The present state of the art can provide for the subsistence of life during this period. For longer flights this system of simple provision-

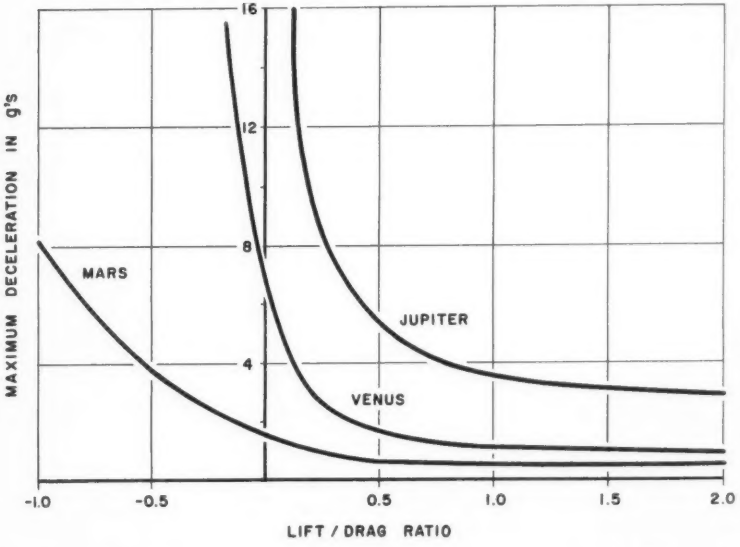

Figure 8. Deceleration at re-entry into planetary atmospheres. (After Chapman[1])

ing is no longer feasible and a closed ecologic system becomes necessary. Such a system does not exist yet and its development is quite a challenge to the physiologist. In contrast thereto, the technologic basis for extended orbital flights is available. Such flights in manned vehicles could be undertaken if a closed life-sustaining system would exist. During the next decade we certainly can expect developments in this direction.

This work then will lay the groundwork for interplanetary flights, which also appear technically feasible today. New problems will arise as we tackle visits to other planets. The differences in gravitation and atmospheres change the picture of launching and re-entry, and it is quite interesting to compare some of the aspects of re-entry into atmosphere of other planets. The deceleration encountered when entering the atmosphere of the planets Jupiter, Mars, and Venus in contrast to the decel-

eration experienced in the terrestrial atmosphere is shown in figure 8.

You can see that Mars will pose the smallest problem as far as deceleration is concerned. The reason is, of course, that the atmosphere is rather thin and gravity is only about one third of a terrestrial G. Venus is about the same as Earth, as was shown in figure 6, but Jupiter certainly presents a problem. A pure drag vehicle would produce too much deceleration and lift is absolutely necessary. Sustained flight at low velocities appears quite troublesome because of Jupiter's high gravity.

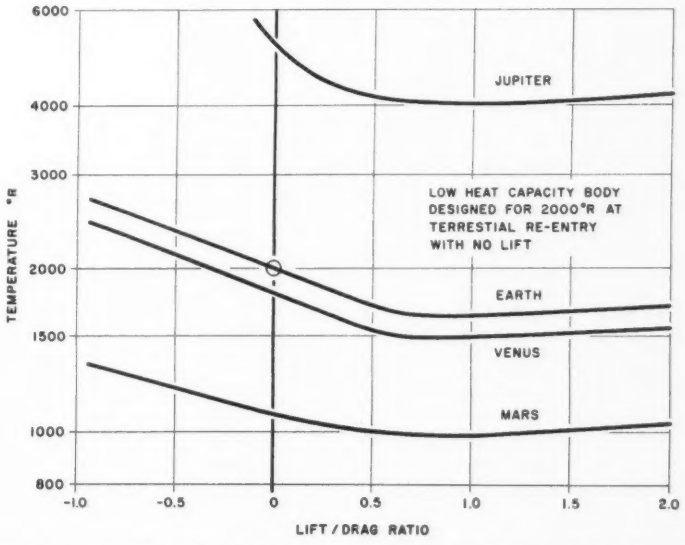

Figure 9. Temperature at re-entry into planetary atmospheres. (After Chapman[1])

Aerodynamic heating in the various planetary atmospheres is also quite different from the heating in the terrestrial atmosphere. Let's assume that a nonlifting vehicle is designed to reach 2000°Rankine upon re-entering the atmosphere of the earth. If we have a low capacity structure, the temperature will vary with the application of lift, as explained before. The same vehicle in other atmospheres will attain temperatures varying in about the same manner as is shown in figure 9. The temperature level, however, differs greatly depending on the planet. Again, Mars offers the least difficulties with Venus, earth, and Jupiter following. Jupiter in all respects certainly appears to be a forbidding planet.

I have attempted to give you a brief glimpse at the problems of re-entry. Their implications relative to a manned satellite need no further explanations. Again, there is a strong correlation between the state of the art and space medical problems. Today the only way to control re-entry is by means of aerodynamic forces. Drag, being the simplest one, will be used first. Later, certainly, lift will be employed as soon as the problems associated with lift generation for practical applications are mastered, In the future, when engine thrust can be used more efficiently not only for launching but also for re-entry, and when the generation of forces through other means than aerodynamics becomes feasible, the problems of a re-entering vehicle and its consequences for its occupant become greatly simplified. I am confident that in the next decade we will see such progress, where refinements of the state of the art will take place. It is also clear that major breakthroughs are required to take space flight out of the adventure category and make it a practical routine.

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THE EMOTIONAL SYMBOLISM OF SKIN

When one asks a patient with a skin disability, 'What does your skin mean to you?' one often gets the reply, 'Well, it's what keeps me together. It is me. When it looks good I feel good. When it looks bad, it gets me down, or I feel inferior;' and of course those suffering from acne often say, 'I want to get away from everything. It embarrasses me, and I have feelings of being dirty or inferior.' The skin is also charged with emotional symbolism. This is clearly shown in phrases such as 'getting hot under the collar,' symbolizing rage; 'I am itching to get my hands on him' signifies a desire for an aggressive act. Phrases like 'my hair stood on end' and 'I am in a cold sweat' indicate intense anxiety, and being 'tough skinned' or 'thin skinned' denotes degrees of emotional sensitivity. The expression 'I would not want to be in his skin for anything' is the same as saying 'I don't want to be that person.' In this respect the skin can also be regarded as if it were the total personality.—J. Frootko: The Changing Pattern of Dermatology. *Medical Proceedings*, (Johannesburg) 10 January 1959.

THE AEROMEDICAL REALITIES OF SPACE TRAVEL

M. S. WHITE, *Brigadier General, USAF (MC)*

IT IS AN HONOR and privilege to address this great congress of aviation medicine as a representative of both the Aero Medical Association and the United States Air Force. I bring to you the warm felicitations of both organizations and their best wishes for a most successful meeting.

The past of aviation medicine and its progress to the realities of space travel cannot properly be discussed from the point of view of one nation alone. You need only be reminded that the need for and the recognition of aviation medicine as an organized science began on this continent with the interest of many groups.[8] Therefore, it is most fitting that this Third European and First World Congress of Aviation Medicine take place in such an historic environment and under such appropriate auspices.

It was in Europe in the war of 1914-1918 that flying operational experiences taught that human error rather than enemy action contributed to the majority of aircraft losses. This led to the rapid development of aviation medicine as a science to assist the flyer. Following World War I, aviation medicine was firmly recognized at the first international conference in this specialty in Rome in 1919. Later in this country, in nearby Brussels, in 1935 there was an outstanding conference on an important function of aviation medicine. This was the Third Congress of L'Aviation Sanitaire.

In the delightful and stimulating surroundings of Louvain, we are aware that this is the birthplace of many notable contributions to science. Of interest to flight surgeons concerned with the use of oxygen and other gases, was the work of a Capuchin friar, Jean Baptiste Van Helmont, who was educated in Louvain in the sixteenth century. This learned scholar originated the word "gas" which he derived from Paracelsus' use of the Greek

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From the Office of the Surgeon General, Department of the Air Force, Washington, D. C. General White is president of the Aero Medical Association.

Presented on 23 September 1958 at the Third European Congress of Aviation Medicine, Louvain, Belgium. Reprinted with permission from *The Journal of Aviation Medicine*, 29: 707-715, October 1958.

chaos for the general sense of air.[6] Each bit of information contributed by many such pioneers in all branches of science over the years, with Paul Bert's monumental *La Pression Barometrique*[4] as an outstanding example, has added significantly to the knowledge now embodied in the specialty of aviation medicine and supported man's progressive attempts to project himself into space.

The earliest steps into space began in November 1783 on this continent with the first manned flight of a free balloon piloted by the French apothecary from Metz, Francois Pilatre de Rozier, with Marquis d'Arlandes as a passenger.[2] Thus was begun primitively the pattern for today's probings of our upper atmosphere by

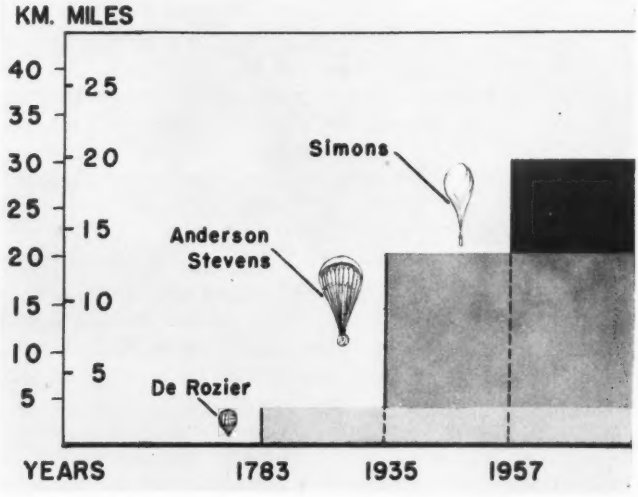

Figure 1. Man's progressive steps into space by balloon.

modern balloonists in sealed gondolas. These ventures into the atmosphere to space-equivalent altitudes by balloon ascensions are marked, prior to Simons' monumental feat in 1957, by the pioneering flights of Piccard in Europe in 1931 and 1932,[11] and in the United States by the National Geographic Society—U. S. Army Air Corps stratospheric ascensions in 1934 and 1935 of *Explorer* I and II.[12,13] These progressively upward steps to space are depicted in figure 1. It is of interest to note that in the flights of the 1930's an artificial atmosphere was first used in a sealed compartment to conquer one of the major problems of space flight—hypoxia. Studies similar to present investigations were carried out by scientists on samples of atmosphere, and on cosmic rays and their effects on fruit flies, ozone, the

absorption of carbon dioxide in a closed atmosphere, spores and bacteria, and the problems of communication. The aviation medical aspects of the *Explorer* I and II flights, which reached an altitude of 11.5 miles and 13.71 miles, were reported by a flight surgeon, Captain Harry G. Armstrong, later surgeon general of the Air Force.[3] Thus was undoubtedly kindled the spark which led this indefatigable investigator, when commandant of the United States Air Force School of Aviation Medicine, to establish the first department of space medicine in the world at that institution in 1949. A further sequel was the organization of a Space Medicine Branch of the Aero Medical Association in 1950.

I cannot leave the subject of balloon ascensions and historic flights without calling to your attention a further debt that America has to the old world. That was the first ascent of man into the air of the new world which took place on January 9, 1793 when a Frenchman, Jean Pierre Blanchard, took off from Philadelphia and landed 15 miles away at Woodbury, New Jersey.[7] To illustrate again the similarity to present-day experimenters, the only passenger with M. Blanchard was a small black dog, undoubtedly now a spiritual confrere of the recent intrepid voyager, Laika. The same Blanchard was the pilot of an earlier pioneering flight, the first over water from England to France on January 7, 1785, when he was accompanied by the first flying physician, Dr. John Jeffries of Boston.[2]

Thus the conquest of space began. As knowledge grew in all scientific fields, man's perpetual desire to increase the speed, altitude, and duration of flight resulted in the dynamic progress in aviation we know today. Aviation medicine has advanced with and supported the developments of the aeronautical sciences. Now, in the present most dramatic transition period of aviation history, man, due to aviation medicine, has attained space-equivalent capability. His goal, as it has been with each successful step up the vertical frontier of space, will continue to be "onward to the stars."

When we speak of reaching the stars, we frequently talk glibly of space flight and outer space. Here pause must be made to analyze our present position and determine how far we have penetrated the infinite universe in which our small planet Earth exists. To gain a proper perspective and outline obtainable goals for the future some orientation is necessary. Photographs of the heavens have been made in a sky survey conducted by the Palomar Observatory and the California Institute of Technology.[10] The telescope used in the survey, the Big Schmidt, with a 48-inch mirror is able in its maximum range to capture clear, high-definition photographs of heavenly bodies as distant as a billion light years. The extent of this measure is realized when we

consider that just one single light year calculated at the speed of light of 186,000 miles a second is equivalent to a distance of 5.8 million miles. The objectives of this sky survey were to increase man's knowledge of the celestial bodies and other phenomena in the Milky Way, the galaxy of which the solar system containing the earth is a part. In figure 2 is the cone nebula, photographed with the more powerful 200-inch reflector of the Hale telescope, which can double the range of penetration

Figure 2. Detail of cone nebula. Photographed with 200-inch Hale telescope.

into space to the almost incomprehensible distance of two billion light years. If, through some miraculous development, man could project himself from the earth at the speed of light he would not reach the vicinity of this beautiful area depicted in the heavens for 20 million centuries.[10] Based on present concepts of space and time, this goal of space flight is beyond our attainment. However, it does illustrate how inclusive and incorrectly we frequently use the terms "space" and "space flight." When we

draw closer to the earth and direct our attention to this planet's nearest star, the sun, which is only 8.3 minutes away by speed of light time, or a mean of 93 million miles, we see that again we are forced by time and space factors to relatively limited space travel. Under present concepts, a trip to the planet Pluto located in our solar system but farthest from us and the sun—a distance of five and one-half hours at the speed of light or 50 years in supersonic flight—would be beyond one man's active lifetime.[1]

Figure 3. Spiral nebula in Andromeda. A galaxy similar in shape to the Milky Way galaxy in which our solar system is located.

Perhaps in some future generation a reorientation in, or a totally new theory of, relativity will permit true space exploration to other areas within our own Milky Way galaxy, or to those thousands of other galaxies now measured as billions of light years away. We must recognize the futility of this type of space travel today and return from these metaphysical regions to

present-day atmospheric flight and the role of aviation medicine. The distance between any neighboring galaxy system averages two billion light years of distance. A representation of what our own Milky Way galaxy may look like when viewed from afar is seen in figure 3, a photograph of a spiral nebula in Andromeda, a neighboring galaxy. It is not unlike a large wheel seen edgewise, with rounded streamline projections at its hub on either side. Buried in a similar wheel-like formation of the Milky Way, which has a diameter of from 80 to 100 thousand light years and a thickness of 10 thousand light years, is our own solar system. A manned mission from earth would have to travel 15,000 light years just to cross the Milky Way's nearest frontier before it could be claimed that intergalactic travel had commenced.[10]

Our immediate attention must be focused on a very small area of the universe that is our own frontyard. Though we may speak facilely of space travel, we are really referring only to the further extensions of height, duration and speed that have always been the goals of man's increasing penetration of the atmosphere.

The atmosphere of the earth can be considered for significant functional purposes to extend to 120 miles with approximately 99 per cent of its mass within 20 miles of the earth (fig. 4).[5] The remaining 1 per cent may extend from 6,000 even to 60,000 miles, dependent on various interpretations of molecular distribution. At the present, man has conquered atmospheric flight and space-equivalent flight. The next important step prior to entering true space will be circumplanetary flight at the outer fringes of the atmospheric layer. The attendant medical problems of such flight, of which this audience is well aware, have been analyzed and most have been solved. Many of these problems will be discussed at the meetings of this congress. Progressively, the objectives are clear and a timetable has been drawn.[9] Following earth satellite flights and the unmanned luna probes, the next goal of man will be the moon, a distance of about 240,000 miles, or 1.3 seconds if measured at the velocity of light, or, if measured in projected flight times, one day to one week dependent on the trajectory of flight and the initial velocity of the vehicle. Figure 5 is a photograph of the moon at 14-day stage with a 48-inch Palomar telescope. A closer view of a portion of the surface facing future explorers is seen in figure 6, made with the more powerful 200-inch Hale telescope.

The successful accomplishment of lunar flight will pave the way for further exploration and interplanetary travel which, while similar from a mathematical and medical point of view, will be more extensive in having a greater number of major phases. There will be problems associated with markedly-extended times of flight, new navigation methods, strain on present

communication techniques, entry into unknown atmospheres and radiation belts, and the fact that some requisite knowledge as the precise composition of planetary masses is still unknown. Venus and Mars, the most intriguing planets as well as the closest to earth, with Venus only 6 minutes away measured in speed of light time or 26 million miles, and Mars 12½ minutes away or 35 million miles, will undoubtedly merit attention first. Here consideration must be given to flight time which will con-

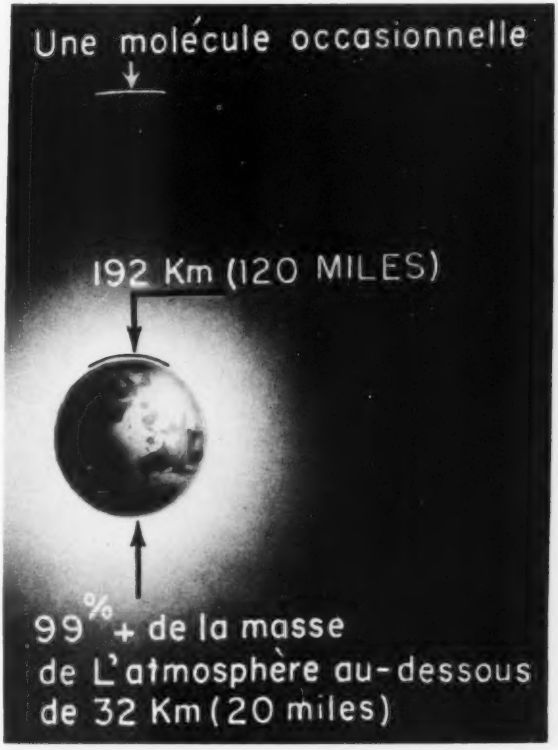

Figure 4. Diagrammatic representation of distribution of earth's atmospheric mass. (From P. A. Campbell[6])

sume years rather than days under hoped for conditions of travel. Because of the cloud cover of Venus, nothing concerning its surface is known. Venus will be a surprise planet when visited by the pioneer astronauts.[1] Much more is known about Mars. Conditions on its surface are very similar, with regard to temperature and pressure, to stratospheric conditions eleven miles above the earth's surface.[14]

As techniques improve, and the many problems of vehicular propulsion, guidance, and internal environment for longer voyages are conquered, the further exploration of our solar system can become a reality. Future scientific exploration will be impossible, however, without the continued contributions of aviation medicine, or flight medicine, as it should now properly be called. The eventual benefits to mankind from the research endeavors in the basic medical problems associated with space flight are unlimited. Many notable dividends to medical progress have been made through past activities of aviation medicine. Contributions have been made in oxygen and carbon dioxide studies, pressure

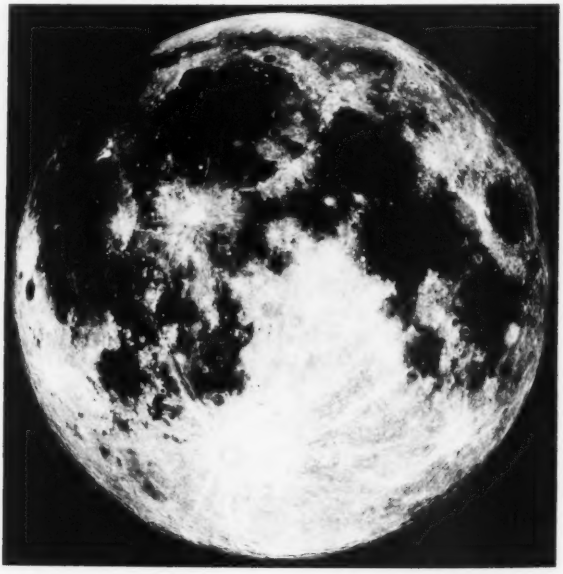

Figure 5. Moon at age 14 days. Photographed with 48-inch Palomar telescope.

breathing, dysbarism, cardiovascular and respiratory dynamics, and body temperature response. In public health, advances have been made in the practical field of bringing rapid succor through airlift to stricken communities, in the air transport of critically ill patients, and in the development of protective measures for crash deceleration. In addition, progress in preventive medicine has been made in the control of disease factors precipitated by global air transportation.

Untold possibilities for increased knowledge are in store for the future in the exploration of new environments, new worlds, and a radical change of earthbound perspective. Man must be

studied in this new situation by a careful analysis of his systemic capabilities and limitations. Research must be directed to the biochemical and biophysical reactions of the central nervous system, to problems of the special sensorium and impulse transmission, and to musculoskeletal, respiratory, cardiovascular, gastrointestinal, genitourinary, humeral and glandular activities. We can hope that the phenomenal discoveries awaiting us in all scientific fields, as man's endless exploratory quest continues,

Figure 6. Region of Clavius of the moon. Photographed with 200-inch Hale telescope.

will also aid in solving many of the baffling medical problems now facing us here on earth.

A view of our small planet following its orderly course in the infinite universe containing billions of more suns larger than ours, each with its own planetary system, cannot fail to make one appreciate the universal brotherhood that unites earthly humans into one family. With such an outlook, international goals

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become as one. Through meetings such as this world congress, with its mutual exchange of information, progress into the future is assured. Aviation supported by aviation medicine has shrunk world dimensions, making all nations neighbors. The next step into circumplanetary flight on the fringes of our atmosphere, an environment shared equally by all inhabitants of a revolving earth, will contribute even more to this sense of one family and one world.

Medicine with the noblest humanitarian goals serves as a common denominator to human brotherhood and everlasting peace. Aviation or flight medicine and its extension into space is at the forefront of that relationship, to speed the day when nations are composed of men of good will, when human dignity is respected, and the common good is the goal of all people. Advances gained in scientific knowledge of the earth, the solar system and the universe, will benefit all mankind as we continue our quest higher and higher, closer to the secret of life itself.

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WORK LESS, LIVE LONGER

At the turn of the century a man worked 70 hours a week and had a life expectancy of about 40 years. Now he works forty hours and has a life expectancy of 70 years. In 1900 only four out of a dozen funerals were for persons who had lived 50 years or more; now every ten out of a dozen are for people over 50.—George F. Lull: Development of Medical Practice and Trends. *Connecticut Medicine,* February 1959.

PSYCHOLOGIC ASPECTS OF THE "NAUTILUS" TRANSPOLAR CRUISE

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THE recent transpolar cruise of the USS *Nautilus* (SSN-571) provided a unique opportunity to observe and evaluate the interpersonal relationships of a rather isolated group faced with hazards of unknown degree while performing a historic mission. It was my privilege to be on board the *Nautilus* during both phases of Operation Sunshine, for the purpose of uncovering and defining potential problems relating to the Polaris weapons system in which the fleet ballistic missile submarine will be the launching platform for a solid propellant intermediate range ballistic missile (IRBM). The two basic areas of interest can be roughly divided into environmental and psychologic. This article will be concerned only with the psychologic aspects of the operation except where the environmental factors were intimately related to the psychologic.

Operation Sunshine was conducted in two phases; the first of these began 8 June 1958 upon departure from Seattle, Washington. This phase consisted of a high-speed run to the Aleutian chain, transit of the Bering Sea east of St. Lawrence Island after a westward passage was halted by heavy ice in relatively shallow water, and an uneventful transit of the Bering Strait to the Chukchi Sea. After penetrating northward to 69° on meridian 167° W, the probing mission of this phase was terminated. It was decided that a return to Pearl Harbor to await more favorable conditions for an Arctic transit was the prudent course. On 12 June, the *Nautilus* steamed south toward Pearl Harbor arriving there on 28 June.

The second phase of the operation began 22 July 1958 upon departure from Pearl Harbor (figs. 1 and 2) for another high-speed run to the Aleutian Islands. This time an ice-free passage west of St. Lawrence Island was successful. Again the Bering Strait was left behind as the *Nautilus* steamed north in the Chukchi Sea. On about the same track as phase 1, the *Nautilus* was able to penetrate almost to latitude 73° N before being forced by heavy

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ice formations and relatively shallow water to seek another passage to the deep water of the Arctic Basin. This was found by running eastward to a location just off Point Barrow, Alaska, where a sea canyon begins relatively close to the Alaskan coast and rapidly deepens to several hundred fathoms. This point was reached early on 1 August. The *Nautilus* dove and began the under-ice portion of the cruise that took us under the North Pole on 3 August and found us in the open water of the Greenland Sea on 5 August 1958. The remainder of the cruise was routine.

Figure 1. Crew members of the U. S. S. Nautilus *prepare to get under way from Pearl Harbor, T. H., for the trip under the polar ice.*

A combination of several stress producing factors were encountered during this operation: (1) an extended period away from home and families; (2) the isolation of prolonged submerged runs; (3) hazardous conditions such as 96 hours under the polar ice cap; and (4) participation in a historic event, the first transit of the Arctic Ocean from Pacific to Atlantic via the geographic North Pole. In other words, the personnel on board were observed during the anticipation of adventure and trail blazing, the frustrating aspects of delays due to heavy ice and relatively shallow water, and the satisfaction of success and a job well done. In the face of this series of emotion-provoking situations there were no major psychologic problems. As a matter of fact there were no minor problems of a psychologic nature if by the term "problem" a need for medical or psychiatric therapy is implied. This is consistent with previous reports of neuropsychiatric casualties on submarines. During World War II only 56 cases were reported from 1,500 war patrols that included approximately

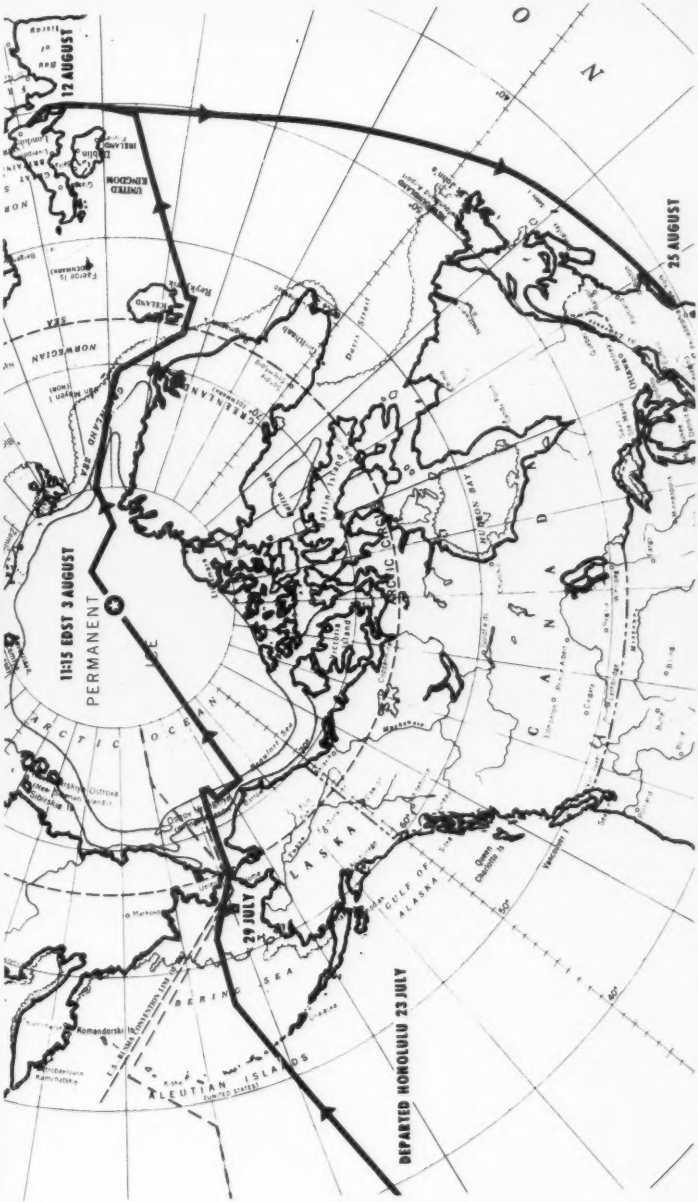

Figure 2. Route taken by the Nautilus *on her transpolar trip that began 23 July 1958 and terminated at New York 25 August 1958.*

120,000 man-exposures. This article, therefore, will discuss factors that influenced morale and motivation.

A few of the many factors that aided in maintaining high morale will be listed and commented upon. Four major items that are so obvious they are often overlooked are: (1) a ship that performance-wise has met or exceeded every demand; (2) a technically skilled crew; (3) exceptionally competent officers professionally; and (4) outstanding leadership. All of these were effectively integrated so that the over-all level of morale was greater than could be expected from pure addition of the single factors.

MAINTAINING HIGH MORALE AND MOTIVATION

Environmental Devices. Contributing a great deal to morale was the *Nautilus* herself. Past performance including the Arctic under ice experience in 1957 had won the confidence of all hands in the reliability of the power plant. This confidence was well placed as never once was there a suggestion of failure in the mechanical plant. The various types of sonar equipment designed to determine depth under the keel, depth below the surface, thickness of ice above and presence of ice ahead added to the feeling of security. Advanced navigational equipment was an important factor in maintaining confidence and morale.

The closed circuit television with the topside camera was more than a device to entertain personnel with observations of open leads and thin ice in the ice pack overhead. It provided accurate visual observations that could be plotted for use later, in the event an emergency surfacing was necessary. Also, during an emergency surfacing it could be used to rapidly scan the open area of the sea and the surrounding ice to minimize the danger of topside damage to the submarine during the operation.

During the entire cruise atmospheric conditions were maintained at levels consistent with health and comfort. For example, the oxygen concentration averaged 20 per cent and the carbon dioxide level was below 1.5 per cent. Temperature and relative humidity were close to ideal with the former varying from 72° to 76° F and the latter from 40 to 50 per cent.

The installation of an emergency air breathing system (fig. 3) with masks and quick disconnect hoses, capable of being attached to air manifolds at all duty stations as well as in the ward room and crew's mess, added to everyone's confidence that even a fire or radiation casualty under the ice would not require immediate surfacing for ventilation. Pure air from the air banks would be available for a considerable period giving time to search for a suitable place to surface.

In addition to these basic engineering contributions to esprit de corps, there are other installations that, although not directly essential to the operation of the ship, nevertheless are important

indirectly as they keep the crew pleased and happy. For example, the availability of a washing machine offset the somewhat limited locker space on board and still enabled the men to have regular changes of clean clothing. The fresh water-making capacity was sufficient to permit frequent bathing by all hands, a privilege unheard of on a conventional type submarine. These items are pointed up by one incident that occurred. An experiment was set up by the Medical Research Laboratory, New London, Connecticut, and conducted by the ship's medical officer to determine the effectiveness of a new chemical in keeping treated undershirts odorless. The experimental design required the subjects to go two periods of four days each without a shower. There were mild objections and considerable joking about the fact that this was unnecessary on the *Nautilus* and, indeed, except under unusual circumstances, it was unnecessary.

Figure 3. Engineman demonstrates the emergency breathing system as the U. S. S. Nautilus *begins her transpolar voyage.*

Food was plentiful, of excellent quality and exceptionally well prepared. An outstanding item was the fresh-baked breads served every morning. In spite of the copious quantities of good food, no unusual weight gains were noted among the personnel.

Music was furnished through a jukebox with 100 selections available from three selector stations, one each in the wardroom, chief petty officer's lounge and the crew's mess. There also was a high fidelity tape reproducer with a large variety of taped recordings that could be played over the same system as the

jukebox or listened to with earphones. There were sufficient speaker outlets throughout the ship so that music was available in most areas. The popularity of this facility is attested by the fact that it was a rare occasion, indeed, when music could not be heard over the system. One such occasion was the minute of silence requested by the commanding officer at the moment of crossing the North Pole.

Music was utilized not only for the primary listening pleasure derived from hearing favorite selections but also as an agreeable background for meals, card playing, letter writing or reading. It must be noted that there was never complete agreement on the type of music to be played. With selectors available to all, the procedure was entirely democratic and no selector had precedence over any other. Indeed, it appeared that any music was preferable to no music. The almost continuous use of this type of auditory stimulation may have had its source in the reduced sensory stimulation of the submarine's confined environment.

The choice of records and tapes varied from rock and roll to the classics with a generous selection of ballads, Dixieland jazz, waltzes, and standard numbers. There also were some novelty numbers which seemed to arouse stronger likes and dislikes than any other types. The meaning of this latter observation is not clear but suggests that an expertly planned program might even be more effective than the present method.

Reading was also a favorite pastime of most every one on board. The choice of reading material was wide and varied from serious nonfiction to frivolous fiction, cartoons, and photographs in the "playboy" type magazine. The serious reading material included technical books and publications necessary to advancement in rate and qualification aboard a nuclear-powered submarine. During the cruise there was a concerted effort to stimulate as many unqualified crewmen as possible to complete their qualifications. The success of this drive was furthered by the fact that a special qualification ceremony was to be held at the North Pole. Its success was evident as 11 men appeared to be congratulated by the captain on having completed their qualifications for nuclear submarines.

Interpersonal Devices. The discussion of the psychologic aspects of the voyage should include consideration of the various ways in which morale and motivation were maintained at a high level, as well as some of the methods utilized to reduce anxiety and tension. This is not to imply that abnormal anxiety was present or observed but to indicate that the usual tensions resulting from daily routines, personal interrelationships, and responsibilities related to the over-all situation were met and adequately dealt with by various means. These included anything from planned programs such as the movie schedule and card tournaments

to the less organized and sometimes more subtle devices such as arguments, physical horseplay and joking. Professional competence, technical skills, and the important but difficult-to-define factor, leadership, also played eminent roles in this respect. It should be pointed out again that there was no apparent awareness of anxiety or the need for its reduction.

Any means used to maintain high morale, keep the individual busy, interested or entertained can be considered an anxiety or tension reducing agent. Among the many ways for accomplishing this during the cruise were tournaments of various types of games such as cribbage, acey deucey, pinochle, checkers and chess. These games were also played frequently both before and after the tournaments were completed. The tournaments served several purposes in that they organized the competition, produced a champion and added a small cash reward from the entry fees. In addition to the competitive efforts inspired by the tournaments were the contests run to determine the design of a distinctive flag to fly entering harbor, and an appropriate name to assign to the individuals transiting the Arctic via the North Pole. The incentive in each case was a 72-hour liberty in England. Both contests provided opportunity for thought, discussion and, in the case of the flag contest, creative effort. The interest and activity generated by these contests was definitely beneficial in maintaining a high level of morale. It is believed that personal or "local" goals are an important supplement to the major goals of a mission. In fact, local goals may increase in importance in maintaining morale as the more glamorous and romantic goals are gradually replaced by routine operations. The value to the individual of being the cribbage tournament champion, of creating a prize bit of handicraft, or completing a college course for credit could conceivably be relatively greater and his feelings of personal achievement more satisfying than the achievement of a nonglamorous major goal for the fifth or sixth time. Personal goals will then become necessary to fill up time, utilize available energy and to give meaning to the daily life of the group.

Movies (fig. 4) provided an important recreational feature during the operation. At first sight it might seem that movies represent an environmental factor in the maintenance of morale. While this is true, movies also make an equally significant contribution to morale by acting as a medium for emotional release. For this reason they are discussed in this section. The crew's messing compartment can be rapidly converted from a dining space seating 36 to a movie theater seating 50 people. This is done by tilting three of the table tops to the vertical position and rigging the extra benches concealed beneath. The sound movie projector is contained in a recess in the after bulkhead and is merely swung into place, plugged in, the reel placed in position and film threaded. The screen is lowered from overhead and the movie theater is ready.

The importance of movies as the principal organized entertainment on board and as the prime contribution to good morale makes their proper selection a matter of considerable concern. Type and quality are the main items to be considered in making a selection. From a series of casual inquiries among the crew it appeared that type preferences can be rated roughly in the following order: (1) good westerns; (2) mystery and good science fiction; (3) comedy, classical drama and musicals grouped at approximately the same level of preference. It should be noted that a pretty girl, particularly if scantily clad, will be most favorably received and provoke a favorable response to any type of picture. Color pictures are preferred but black-and-white films are acceptable, provided that other desirable aspects of type and quality are apparent.

Figure 4. Crew members attending one of the two daily movie showings as the Nautilus *passes under the arctic ice.*

It might seem at first blush that top-grade pictures should unqualifiedly be chosen for long cruises but this is not necessarily desirable. The selection of a few poor quality pictures is advisable. The purpose of this is not so much to show the contrast between good and bad pictures but to mobilize, activate and release anxiety, particularly that occuring from a more or less repressed feeling of hostility. This hostility is a normal reaction similar to and related to the normal anxiety developed in everyday interaction among groups. An example of this release mechanism in action follows.

The first few poor pictures, in a sequence of poor pictures, produced many sarcastic comments and much infectious laughter. The evidence that this provides a tension reducing effect is strengthened by the observation that after several poor pictures

were shown in sequence, the tension was reduced to the point where there was little or no comment or laughter, in spite of obvious opportunities. In other words, the effectiveness of the poor picture in reducing tension was rather short lived. The entertainment value, the diversion from immediate problems, and the pleasures of identification with the actors in good pictures was beneficial over a much longer period.

In the isolation and confined environment of a submarine on a prolonged submerged operation, many common mechanisms for reducing anxiety are utilized routinely but to a large measure subconsciously. For example, if one uses the Freudian concept of the use of humor as an outlet for hostility and as a release for tension, then some of the behavioral interactions among the submarine personnel can be identified readily. It is not the purpose of this report to delve deeply into the dynamics of wit and humor. It should be noted that humor does have an important function other than providing "fun," was utilized in several forms during the cruise, and for the most part was well within the range of social acceptability.

It was observed during the cruise that apparently self-elected and more or less permanently established jokers or humorists were present among officers and chief petty officers as well as among the enlisted men. This does not imply that their operations were necessarily confined to their own group, although this was more commonly so. Their "appointment" was apparently based upon one or more factors. These were native talent in the field of wit and humor, their own emotional needs, skill resulting from experience and practice of the art, and recognition, to some extent subconsciously, of the emotional needs of others in the group for their services.

The methodology varied from person to person and from time to time even when perpetrated by the same individual. There were certain effects, however, that apparently remained constant. First, the humorist was assured of being the center of attention for the duration of his act. Many times this was ego satisfying in that this implies domination of the group, if only for a short time, similar to the court jester of old. Secondly, he is rewarded by the group's laughter. This amounts to group approval resulting from tension release during laughter and from which the jester may gain an additional dividend of pleasure by joining in the general outburst. If a victim or scapegoat is involved, as is often the case, further pleasure may be derived by both the group and the humorist from the victim's discomfort.

The variations in dispensing humor are too numerous to discuss individually but a brief presentation of the more commonly used ways and means follow. Some humor is not essentially directed toward any specific individual but is designed merely to please

the group and thus gain approval for the dispenser. This was done in most cases by using a current subject or situation for a base line and then by a clever play on words, such as by punning, providing a double meaning or by the more obvious means of injecting the "off-color" theme. This apparently is done hopefully to evoke a quick response of laughter. Once the pleasurable effect of the anxiety reduction from the first hearty laughter is experienced by the group, it is relatively simple to proceed by elaboration of the theme or by substitution of a related one to expand the situation until all of those present are satiated. The entire procedure usually includes other contributors getting into the act to supplement the merriment.

Not all of the laughter-provoking methods can be considered truly funny, some are obviously aggressive in nature, and some may be of relatively serious intent initially at least. Arguments of various kinds are an example of the latter. Arguments may begin over an honest difference of opinion and then deteriorate as others enter the picture and supply a touch of ridicule or humor to the situation. In some cases the situation resulting in an argument has been carefully set up by others with entertainment of the group in mind. This implies the selection of a victim or victims that is an interesting procedure involving interpersonal relationships. There are several ways by which an individual can be picked for this role. For example, the victim may subconsciously although apparently deliberately "select" himself by remarks or behavior that demands the attention of the group and the specific response of the joker in the group. In other instances the jester may select a likely individual and either make a sharp aggressive frontal attack with everyone present aware of the entire procedure or by sly innuendoes provoke a response with the audience more or less unaware of the identity of the victim until he responds to the baiting. Still another method is for the jester to make opening remarks in an apparently casual manner with no specific victim in mind and wait until some one takes the bait or accepts the challenge. The various methods parallel in many respects the behavioral patterns observed in a family group. The more experienced and higher ranked or rated individuals represent authoritarian figures and the others display sibling-type rivalry in an effort to maintain or improve their status. Similar also to many family interrelationships are the strong emotional bonds that, in spite of arguments, practical jokes and verbal needling, keep the group functioning as a well-integrated team and preclude deterioration of interdependent feeling for one another.

Another humorous-aggressive device successfully utilized was the newspaper or so-called "scandal sheet." As there were extremely few opportunities to copy newspaper columns, the news items, as the name of the paper indicates, were based upon re-

marks, rumors, behavior, and reports regarding the personnel aboard. Among the articles printed were real or fancied events occurring on liberty, chance remarks overheard by others, the humorous side of serious situations occurring on board, and fictitious material that ranged from the gently chiding to gross slander. The paper like other forms of humor, in spite of its aggressive nature, was eagerly awaited, well accepted, and produced laughs each morning it appeared. The victim, if any, usually joined in the laughter. It is interesting to note that the officers were the principal target of comments with the chief petty officers a close second.

SUMMARY AND CONCLUSIONS

Some of the psychologic aspects of the *Nautilus* transpolar cruise have been reported and discussed. It seems apparent that favorable environmental factors contribute greatly to the maintenance of high morale and strong motivation. These factors include not only those vital to safety and existence under unusual conditions but, for morale purposes possibly of equal importance, those unnecessary but highly desirable facilities that make life on a submarine more pleasant and comfortable. There is much evidence to show that a major increment of morale is provided by the obvious interest of higher echelons in the men's welfare by the very fact that these pleasant and comfortable additions to submarine life are provided. It is believed that many of these items could be more effective in promoting high morale if expert consultation were sought and utilized.

The need for and benefits to be derived from meaningful goals, both major and "local" or personal goals, has been pointed out with the hope that this knowledge will be helpful both in training for and performing future extended operational missions of various types.

In the body of this report it was noted that the gorup interaction paralleled, in many respects, an interrelationship observed in many families. This analogy does not imply that this is the only way a submarine crew can work out their problems of group adjustment. There are many ways. *Skate's* use of an educational program as the principal means to maintain interest and high morale and to demonstrate leadership is another. The point to be emphasized is that in any group, family or submarine crew, interpersonal relationships must take place with a favorable end result in order to ensure a smoothly operating, co-operative, and successful team. It must also be noted that this is not a static affair, even when a satisfactory adjustment has been achieved, but a dynamic procedure with continual interplay of psychologic and environmental forces. The most important implication, therefore, is that, no matter what group interaction is under way, cool, levelheaded leadership of an emotionally

mature commanding officer must be available to maintain a neutral and supportive balance.

It must be remembered that leadership is also a dynamic, complex interrelationship between the leader and his people. This leadership depends not only upon the personality of the leader but upon the varying reactions of the group and the physical environment. It is fortunate that the selection and promotion system of the Navy has built-in factors that tend to assure good leadership. It is also fortunate that the assessment, selection, and training programs for submarine service have been equally effective, as has been commendably demonstrated by the achievement of the officers and men of the *Nautilus*. The successful experience of the past offers a firm point of departure for development of mechanisms for coping with any new parameters future operations may introduce.

THE HAZARDS OF WEIGHT-LIFTING

A review of the literature makes it apparent that lesions caused by weight-lifting rarely appear in the limbs, but are not uncommon in the trunk. We all know that hernias and prolapses can be precipitated by weight-lifting, and anyone who does a bit of spare-time gardening can testify that repeatedly lifting a weed- and clay-laden spade can cause lesions of the soft tissues of the back even though an exact diagnosis cannot always be achieved in such cases. Our orthopedic and neurosurgical colleagues spend much of their time dealing with patients who have lesions of their intervertebral disks, disorders in which acute symptoms often first appear when the patient tries to lift some large and heavy article. There thus appear to be two basic types of injury to the trunk. There is an anterior, *extrusive* group of injuries, which includes visceral hernias and prolapses; and a *spinal* group, including such lesions as lumbosacral strain, prolapsed intervertebral disks at the lumbar and cervical levels, tears of posterior ligaments and spinal muscles, and the less frequent crush fractures of the bodies of the lower thoracic and upper lumbar vertebrae.—Peter R. Davis: Posture of the Trunk During the Lifting of Weights. *British Medical Journal,* January 10, 1959.

EVALUATION OF DIURIL IN 50 PATIENTS WITH TOXEMIAS OF PREGNANCY

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THERE is ample evidence that patients with toxemia of pregnancy have an abnormal water and electrolytes balance. Dieckmann and associates[1] demonstrated that the elimination of sodium and water is delayed in all pregnant patients and is further delayed in patients with toxemia of pregnancy. Important therapeutic measures in the treatment of edema and toxemia of pregnancy include rest, reduction of excessive blood pressure, appropriate dietary control, and administration of an efficient diuretic.

In the past, ammonium chloride and Diamox (brand of acetazolamide) have been used on the obstetric service of this hospital as the diuretics of choice. In November 1957 a study was undertaken to determine the effectiveness of a new diuretic compound, Diuril (brand of chlorothiazide). The results in 50 patients receiving this diuretic are presented in this report.

Previously, 147 patients with mild or moderate preeclampsia with fluid retention and clinical edema were studied to compare the diuretic effectiveness of Diamox with that of ammonium chloride and of bed rest alone.[2] Statistics on these patients are included for the purpose of comparing Diuril with the previously used diuretics. The diagnosis was based on the criteria set forth by the Committee on Maternal Welfare.[3] The diagnostic determination procedures and therapeutic regimen prescribed for patients in the previous study[2] were followed for the present group.

All patients included in these series were admitted to the hospital. All patients who were delivered during this study were excluded. A total of 197 patients were completely evaluated. Of these, 45 were treated with bed rest alone; 42 received ammonium chloride; 60 received 250 mg of Diamox daily;[2] 50 received Diuril. Initially, the patients receiving

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Diuril were given 250 mg daily, but this proved to be inadequate. After dosage was increased to 500 mg daily, effective diuresis was obtained.

RESULTS

The results of the studies are shown in tables 1, 2, and 3.

The age, gravidity, parity, pre-pregnant weight, the gestational week that edema was noted, and the admission weight were comparable for all four groups of patients.

TABLE 1. *Comparison of average weight changes in 197 patients with preeclampsia of pregnancy**

Data	Mean results in patients treated with			
	Diamox (60 patients)	NH_4Cl (42 patients)	Bed rest (45 patients)	Diuril (50 patients)
Age	26.63	26.98	26.80	24.36
Gravida	2.03	2.17	1.87	2.24
Parity	0.89	0.16	0.80	0.98
Pre-pregnant weight	140.80	137.90	145.00	140.50
Week edema noted	34.50	36.10	34.40	33.60
Weight on admission	167.70	164.10	171.50	166.90
Total weight gain	26.90	26.20	26.50	24.30
Weight loss after 5 days of therapy	9.60	7.80	7.20	9.10

*This is a modification of table 1 in reference 2.

After five days of therapy, the average weight loss for patients treated with bed rest alone was 7.2 pounds; with ammonium chloride, 7.8 pounds; with Diamox, 9.6 pounds; and with Diuril, 9.1 pounds. The minimal weight loss after five days of Diuril therapy was 3 pounds and the maximum weight loss in five days was 16.5 pounds. Of the 60 patients treated with Diamox, several had paresthesias and several had blurring of vision, thought to be caused by ciliary spasm. These symptoms were transitory. There was one case of hematuria, thought to be the result of the sulfonamide-like structure of Diamox inasmuch as the patient was known to be sensitive to sulfonamide and had had a similar toxic manifestation.[2] There were no untoward side effects noted in the 50 patients treated with Diuril.

Of the 50 patients treated with Diuril, 20 had elevated blood pressure. The average mean arterial pressure was 116 mm Hg. Following Diuril therapy there was a reduction of the mean arterial pressure to 88 mm Hg, or an average reduction of 25 per cent. Table 3 illustrates the blood chemistry determina-

tions in patients receiving Diuril. The admission and discharge determinations reflect so little change that it is not thought to be clinically significant. It must be pointed out,

TABLE 2. *Comparison of average blood chemistry studies in 147 patients with preeclampsia of pregnancy*

Constituent	On admission			At discharge		
	Bed rest	NH_4Cl	Diamox	Bed rest	NH_4Cl	Diamox
Blood urea nitrogen (mg/100 ml)	9.3	9.1	9.2	11.1	12.0	11.3
Carbon dioxide (mEq/liter)	20.9	21.1	20.1	21.7	22.0	21.8
A/G ratio	2.8/3.2	2.7/3.1	2.5/3.2	3.0/3.7	3.1/3.4	3.2/3.6
Uric acid (mg/100 ml)	4.7	4.3	4.1	5.2	5.4	5.1
Chloride (mEq/liter)	108	111	115	102	101	100
Sodium (mEq/liter)	135	131	138	130	127	132
Potassium (mEq/liter)	4.1	4.0	4.2	4.0	3.9	4.1
Total protein (grams/100 ml)	6.0	5.9	6.1	7.4	7.5	7.2
Average electrolytes excreted in urine (mEq/24 hours)						
Sodium	90.6	93.5	95.1			
Potassium	41.8	44.3	49.2			
Chloride	140.6	145.4	149.1			

however, that this diuretic was given for only a short time, and the minimal changes in the blood chemistry determinations may not be present if this drug is given over a longer period.

DISCUSSION

Diuril is known chemically as 6-chloro-7-sulfamyl-1, 2, 4-benzothiadiazine-1, 1-dioxide and is designated by the generic name of chlorothiazide. The drug enhances the excretion of sodium and chloride by the renal tubules.[4] The mode of action of Diuril in influencing the excretion of sodium and chloride has not been fully defined. Studies in laboratory animals have shown that Diuril is uniformly and well absorbed following its oral administration and is rapidly eliminated by the kidneys. At effective doses, the compound does not alter significantly glomerular filtration rate or renal plasma flow.[5]

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Since the figures obtained reveal marked comparability, with the exception of total weight loss, it appears that there is little advantage in adding ammonium chloride to a regimen

TABLE 3. *Blood chemistry studies in 50 patients with patients with preeclampsia of pregnancy treated with Diuril*

Constituent	On admission			At discharge		
	Maximum	Minimum	Average	Maximum	Minimum	Average
Blood urea nitrogen (mg/100 ml)	15	3.0	9.5	25	5.0	14.2
Carbon dioxide (mEq/liter)	25.2	18.5	21.8	26.9	17.7	22.9
A/G ratio	-	-	2.8/3.3	-	-	3.1/3.5
Uric acid .(mg/100 ml)	8.2	3.0	5.0	10.8	4.2	6.5
Chloride (mEq/liter)	136	96	105	108	90	100
Sodium (mEq/liter)	147	103	135	143	130	135
Potassium (mEq/liter)	5.3	3.4	4.2	5.0	3.1	4.0
Total protein (grams/100 ml)	6.7	5.4	6.1	8.2	6.3	7.6
Average electrolytes excreted in urine (mEq/24 hours)						
Sodium	241.5	13.0	96.9			
Potassium	122.4	9.6	50.4			
Chloride	235.0	74.0	152.2			

consisting of bed rest alone, because the total weight reduction is almost identical. The total weight loss in the patients given either Diuril or Diamox is also comparable and is significantly increased over those patients given ammonium chloride or only bed rest. While the patients receiving Diamox lost slightly more weight than those treated with Diuril (table 1), the difference is so slight that it is not clinically significant. This slight difference certainly is offset by the obviously lower incidence of toxic manifestations of Diuril.

SUMMARY

The effectiveness of Diuril in producing diuresis in patients having preeclampsia with edema was compared to that of Diamox, ammonium chloride, and of bed rest alone. Bed rest proved to be effective, and the addition of ammonium chloride did not significantly alter the effectiveness. Diamox and

Diuril were both approximately 20 per cent more effective than either bed rest or ammonium chloride.

No significant difference in blood chemistry determinations was found.

There was little difference in the effectiveness of Diuril and Diamox in producing diuresis. Because of the lowered incidence of toxic manifestations encountered with Diuril therapy, it appears that this new diuretic is a valuable adjunct to current methods used in treating preeclamptic patients.

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RESEARCH IN SUBMARINE MEDICINE

In the realm of physiology the results of submarine medical research are of considerable value to all practicing physicians. When the etiology of nitrogen narcosis is finally disclosed, many of the formidable questions of closed-technic gas anesthesia will be solved. Air embolism has become a recurrent tragedy in cardiac and thoracic surgery. Definitive findings in this area of investigation are almost within our grasp and with these answers will surely come some new and useful concepts of human respiratory physiology. The appreciation of pure oxygen as a powerful neurotoxin was derived from early investigation of gases under high partial pressures, but even today this entity is not given proper credence by medical practitioners. Human response and adaptation to carbon dioxide is of major importance in underwater medicine. The problem is equally critical to the internist, the anesthesiologist, and the general practitioner . . . .
—Bartholomew W. Hogan: The Practice of Submarine Medicine. *Medical Arts and Sciences,* Second Quarter, 1958.

Clinicopathologic Conference

Tokyo Army Hospital

NUMBNESS AND PARALYSIS

Summary of Clinical History. A 43-year-old Australian Army sergeant was admitted to this hospital on 16 November 1957 with complaints of numbness of the hands and feet, inability to move, and difficulty in swallowing and talking. He was transferred from the 121st Evacuation Hospital, Korea, on the seriously ill list.

First Hospitalization. The patient was seen in a dispensary of the Australian Armed Forces initially on 12 November with a history of feeling "off color" for two weeks, one week of evening chills, numbness of the hands and feet, and on the 12th of November he complained of numbness and a "woody" feeling about the tongue and mouth. At that time physical examination revealed a normal neurologic status.

The patient was transferred to a medical facility in Inchon, Korea. He had discontinued Paludrine (a British proprietary antimalarial drug) 15 days prior to this admission. A blood smear for malarial parasites was found positive for ring-form trophozoites. Also at this time, vertigo was added to the complaints. Routine antimalaria therapy was started. The patient's temperature, which was 101°F at the time of admission, fell to 96°F and the patient felt weak and exhausted. He complained of glovelike, woolly sensations in both hands, present on movement of both his arms. His feet felt wooden, and he was unable to walk. He felt dizzy on standing. An examiner reported loss of position sense, although the patient was able to assess a

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At the time of this conference, Col. Joseph W. Batch, MC, USA, was commanding officer. From the laboratory service, Lt. Col. Slater M. Dozier, MC, USA, chief.

toe-pointing test properly. No definite loss of pain or touch was reported. Vibration sense was equivocal. Deep tendon reflexes were sluggish and difficult to elicit. Plantar response was nil. Slight weakness was suggested in the right leg. The pupils were equal and reacted, with consensual reflexes present. The optic disks were normal.

In view of the neurologic symptoms, the patient was transferred to the 121st Evacuation Hospital. Urinalysis was negative. The white blood cell count was 8,200 per μl, with 66 per cent neutrophils and 31 per cent lymphocytes. Sedimentation rate was 16 mm per hr and hemoglobin was 88 grams per 100 ml. On arrival at that hospital, the history was as previously noted, and on physical examination he was found to be a well-developed, well-nourished man, mentally clear and oriented, but appearing ill. The head and neck were normal. No facial paralysis was noted. (A "droop" noted on the right side of the mouth was considered congenital.) There was no nuchal rigidity. The lungs were clear. The heart was not enlarged. Blood pressure was 140/108 mm Hg. Knee jerks were bilaterally sluggish. Babinski, Brudzinski, and Oppenheim reflexes were negative. There was definite weakness of the right arm, particularly of the deltoid muscles, and there was numbness of the wrists, hands, and feet, but no objective sensory changes were noted. The eye consultant reported the external appearance of the eyes to be normal, the pupils round and reactive to light and accommodation. The optic disks were well outlined, retinal vessels were normal, and no exudates or hemorrhages were seen. Ocular tensions were normal.

On 14 November the patient's blood pressure was 174/130 mm Hg. His general condition remained the same with numbness a prominent complaint. It was thought he might have hypertensive encephalopathy. He vomited on occasion. Following Thorazine (brand of chlorpromazine hydrochloride), the patient felt better. He exhibited progressive difficulty moving about in bed, coughed often, and frequently seemed to be choking. He became unable to feed himself and was then transferred from the 121st Evacuation Hospital to this hospital on 16 November.

SECOND HOSPITALIZATION

Physical Examination. At the time of arrival here, the patient was a litter case. His blood pressure was 148/100 mm Hg; respirations, 26 per minute; and his temperature was 99°F rectally. His pulse was regular. He appeared florid-faced but not cyanotic. No abnormalities were noted about the head or neck, and the neck showed no rigidity. Except for occasional rhonchi, the left side of the chest was clear but auscultation of the right side revealed some dullness and decreased breath sounds at the base, but no rales were heard. Examination of the heart was

normal. The abdomen was obese, but otherwise normal. The patient's speech was slurred, but he was mentally clear. His pupils reacted to light. The optic disks were normal. The gag reflex was intact. Other than the afore-mentioned findings, positive neurologic findings were limited to the following: There was absence of movement in the extremities except for a slight amount of left hand. Slight alternation of sensation was reported on the wrists, hands, and feet. There was questionable impairment of the right facial nerve. All deep tendon reflexes were absent except for questionable reflexes at the wrists. Babinski and Oppenheim reflexes were normal. Abdominal reflexes were absent. The patient was unable to sustain the weight of a passively lifted arm or leg, which fell in a manner characteristic of marked paresis.

Laboratory Studies. Spinal tap on admission revealed a pressure of 168 mm of saline. The spinal fluid was clear; the protein was 91 mg per 100 ml; globulin, 1 plus; glucose, 90; and there were no blood cells. The peripheral blood showed the white blood cell count to be 16,700 per μl, with 83 per cent neutrophils and 15 per cent lymphocytes. The hemoglobin was 15.9 grams per 100 ml. The sedimentation rate was 6 mm per hr. A blood smear was negative for malarial parasites. A roentgenogram of the chest was reported to be normal.

Course in Hospital. Following admission to this hospital, the patient was seen in consultation by the neurologists and by the ear, nose, and throat service because he had increasing difficulty in handling secretions despite the presence of gag reflexes. He also seemed cyanotic. There was progressive loss of even the slight movement in the extremities present on admission. Because of this downhill course, a tracheotomy was performed and the patient was placed in a respirator. He received antibiotics throughout his hospital course.

During his hospital course, the blood pressure varied markedly from 216/140 to 148/100 mm Hg. On several occasions decreased breath sounds in one or the other lung indicated bronchial obstruction in spite of the use of postural drainage and aerosolized detergent. Repeated bronchoscopies cleared these thick secretions. His course, however, was progressively downhill. On two or three occasions of apparent bronchial blockage the patient appeared near death, but he survived these only to die at 1045 hours on 24 November, apparently with clear airways, but seemingly as a result of cardiac failure.

DISCUSSION

Doctor McDowell:* A middle-aged Australian soldier in Korea was ill two weeks, culminating in chills and fever. Blood smear confirmed a

*Lt. Col. Marion E. McDowell, MC, USA, chief, medical service.

diagnosis of malaria, which was presumably cured by "routine" treatment. He continued to be weak, had dizziness, and glovelike subjective sensory changes in the extremities. The subsequent course until his death was only 12 days (less than one month's illness in all). He had general weakness with slight suggestive weakness of his right leg, followed by definite weakness of his right arm; and the lower right side of his face had a droop, thought to be congenital. There was hypertension especially a diastolic hypertension, varying in degree, the patient remained afebrile. Numbness of the extremities remained a prominent part of his illness. The extremities gradually became completely paralyzed and the deep tendon reflexes disappeared. Cranial nerves remained intact (except for questionable right-sided facial palsy). Because of progressive weakness, inability to handle secretions, and cyanosis, a tracheotomy was performed and the patient was placed in a respirator. He was mentally clear until near death. Bronchoscopies were required to clear secretions, but apparently he died with clear airways.

Positive laboratory findings were a white blood cell count of 8,000 per μl, later 16,700 with 83 per cent neutrophils and a normal sedimentation rate. Malaria smear was negative at this hospital. Lumbar puncture demonstrated normal cerebrospinal fluid pressure, with clear fluid; protein, 91 mg per 100 ml; 1 plus globulin; sugar, 90 mg per 100 ml; and no cells.

This story immediately suggests what I am sure was the working diagnosis in this hospital—acute idiopathic polyneuritis (or Landry's paralysis, or Guillain-Barré syndrome). No matter what the pathologist found, this clinical diagnosis cannot be denied—it is almost "textbook"—at least for one of the four principal patterns called idiopathic polyneuritis. Our mission in this CPC is to learn from the case by discussing several questions: (1) Why is this *not* one of many other conditions that are closely related or give very similar clinical syndromes? (2) Does the story (or at the end, does the pathology) suggest any cause for the syndrome? (3) Was there any other disease present causing or contributing to death? And finally, (4) could any of these things have been diagnosed and treated?

Malaria is not uncommon in Korea. Because of this and inasmuch as the ring forms of the parasite were seen in his blood smear, I do not doubt that he had malaria. Nor do I doubt that he was cured of malaria, although we are told only that he was given "routine" antimalarial treatment. This "routine" treatment for vivax malaria nowadays would consist first of chloroquine phosphate, and then should include a longer course of primaquine phosphate to eradicate the tissue phase of the parasite. Even if only chloroquine were given in therapeutic dosage, malaria should have responded, and it seems unlikely that the following short course of illness could be related to malaria.

One must consider whether this illness represents drug toxicity due to chloroguanide hydrochloride, chloroquine, primaquine, atabrine

(brand of quinacrine hydrochloride), quinine, or pamaquine naphthoate. Review of pharmacology textbooks concerning the major observed toxicities of these drugs would not implicate them in a case such as ours, although this cannot be ruled out. Chloroguanide hydrochloride is the most innocuous of the currently used antimalarials, the chief toxic effects being on the gastrointestinal system, and then only in large doses. Chloroquine phosphate may cause a variety of symptoms, but even after prolonged administration in large doses the side effects usually are mild and reversible. Primaquine phosphate may cause abdominal cramps, mild anemia, cyanosis due to methemoglobinemia, leukocytosis, and intravascular hemolysis, especially in Negroes, though the usual dosage of 15 mg (base) per day for 14 days is relatively safe. Both atabrine and quinine may be toxic to the skin, gastrointestinal tract, and central nervous system, but of the nervous system toxicity is more likely to be that of excitation, convulsions, and toxic psychoses rather than flaccid paralysis. Pamaquine's most serious toxic effects are on the blood, but the gastrointestinal tract and the central nervous systems also may be severely affected.

Considering other infections, we would consider poliomyelitis but rather quickly exclude it because of the following features of this case: (1) absence of muscle pain or tenderness; (2) absence of signs of meningeal irritation; (3) progression of paralysis at a stage when there was no fever and no cells in the spinal fluid; and (4) presence of sensory disturbance.

Japanese B encephalitis exists in Korea and is of protean manifestations. Of interest is the fact that there frequently is a leukocytosis with an increase in neutrophils (contrary to what one expects in a virus disease). Early in this man's illness his white blood cell count was normal. Although one would expect to find up to about 250 blood cells (usually lymphocytes) in the cerebrospinal fluid, there have been instances in which no cells were found, so the cerebrospinal fluid findings would fit. Against such a diagnosis are the following: (1) absence of cerebral symptoms such as mental confusion, disorientation, and hallucinations; (2) absence of spasticity, convulsions, or tremors; (3) absence of stiff neck. In fact, the absence of signs of meningeal irritation, and the absence of at least a few blood cells in the spinal fluid excludes the diagnosis of aseptic meningitis, which may be caused by any one of many viruses—such as poliomyelitis, mumps, herpes, lymphocytic choriomeningitis virus, lymphogranuloma venereum, Coxsackie virus, et cetera; or spirochetes such as leptospira or even *Treponema pallidum.* Any of these agents could conceivably be responsible for the Guillain-Barré syndrome as an atypical variant from the usual clinical picture.

It seems reasonable to speculate that some hitherto undiscovered virus or group of viruses may cause the Guillain-Barré syndrome. It is well known that the syndrome may be seen in patients exhibiting the features of infectious mononucleosis. This man did not have the

lymphadenopathy, splenomegaly, sore throat, atypical lymphocytes in peripheral blood, or positive heterophil antibody titer—any one of which would have helped point to infectious mononucleosis—presumably a virus disease.

Concerning the hypertension: In the absence of eyeground findings, congestive heart failure, distended veins, or urinary abnormalities, I would doubt that hypertension was present as a primary etiologic factor. I think it represents a sign of the nervous system disease, but beyond that it does not help me make a specific neurologic diagnosis. I have not found it mentioned in descriptions of the Guillain-Barré syndrome.

I shall close by mentioning two metabolic situations that might be responsible, at least in part, for this case: (1) Porphyria could cause the widespread neurologic findings, but the absence of abdominal or chest pain is strong evidence against it. No family history and no history of dark urine is mentioned. (2) While it is doubtful that chronic potassium depletion, on the basis of undiagnosed renal disease, could have brought about such a rapid and profound paralysis, it is possible that hypokalemia could have developed while he was in the respirator and could have contributed to the paralysis. Neither electrocardiograms nor serum electrolytes are mentioned in the protocol. We will now hear from our neurologist.

Doctor Keller:* It is convenient from the neurologic point of view to group the patient's symptoms into a syndrome of ascending motor and sensory paralysis with mild albuminocytologic dissociation. Rather than using the words Landry-Guillain-Barré-Strohl syndrome one might more properly term this a myeloradiculoneuritis. Many entities can give this picture, some in more and some in less typical fashion. A brief list would include rabies, malaria, diphtheria, infectious mononucleosis, periarteritis, polycythemia, sarcoidosis, alcoholism, vitamin deficiency, Devic's disease, lead poisoning, arteriosclerosis, diabetes, and trichinosis. Particularly important are the reports that an ascending paralysis may precede the appearance of malarial symptoms.[1] Conversely, mainly for interest, it should be mentioned that in diphtheria such a syndrome may present, up to four months after the initial diphtheritic infection, with a high cerebrospinal fluid protein, no cells, and particularly, soft palate weakness and paroxysmal muscle weakness.

With reference to this case, there are some findings that are uncommon for a typical myeloradiculoneuritis, namely, the hypertension, the tendency for weakness to be greater on the right, and the history of vomiting. The first two features might be dismissed because transient hypertension has been reported in this syndrome,[2] and because the weakness is often more pronounced on one side. The vomiting, however, has not been observed in personal experience and was not mentioned in the literature. Conceivably, this could be nothing more than a result of inability to handle secretions but one should not

*Maj. Niklaus J. A. Keller, MC, USA, chief, neurology service.

rationalize so quickly. There is no history of abdominal cramping to suggest porphyria, nor does the history or temperature support a toxic or septic reason for the vomiting.

In summary, a diagnosis of myeloradiculoneuronitis of the typical Landry-Guillain-Barré-Strohl type could readily be made, with the reservations that some atypical features are present and that the possibility of two diseases being present should not be dismissed.

Doctor Baker:* The illness was of short duration, somewhat less than a month. Early symptoms of chills and malaise, and inconclusively described sensory changes apparently heralded malaria, which was confirmed by laboratory studies. The patient's illness, however, progressed onward to further symptoms of central nervous system involvement, despite routine antimalarial treatment. One wonders about the possibility of cerebral malaria, which has a high mortality rate. There is a symptom complex of malaria reported characterized by sudden paraplegia, with sensory disturbances frequently associated with fever. Neurological symptoms may include incontinence. However, the history strongly suggests Guillain-Barré syndrome, which is characterized by polyneuritis, frequent involvement of the facial nerves, and often includes glovelike anesthesia. The generalized weakness, the hyperesthesia, and sluggish reflexes found in this case are commonly seen. The most confirmatory finding, of course, was the increase in albumin in the cerebrospinal fluid, without evidence of cellular reaction. The value reported here is high enough to be of significance.

Dr. McDowell's diagnosis:

Acute idiopathic polyneuritis (or Landry's paralysis, or Guillain-Barré syndrome)

Dr. Keller's diagnosis:

Myeloradiculoneuritis of the typical Landry-Guillain-Barré-Strohl type

PATHOLOGIC FINDINGS

Doctor Dozier: Post-mortem examination of this patient revealed an unobstructed tracheostomy. The lungs were heavy and wet; the right lung weighed 645 grams and the left weighed 600 grams. The trachea and bronchi were filled with thick, tenacious mucus. The apexes of both lungs were slightly fibrotic and contained several small calcific nodules. The coronary arteries showed moderate atherosclerosis. The spleen was slightly congested and weighed 225 grams. Along the lesser curvature of the stomach, there were ulcers measuring from 4 mm to 3 cm in diameter.

After reflection of the scalp, an area of brownish discoloration was noted in the right temporal muscle. There was a linear fracture in the right temporal bone which extended in a horizontal direction. Upon

*Lt. Col. Stewart L. Baker, Jr., MC, USA, chief, neuropsychiatric service.

opening the calvaria, a subdural hematoma, containing an estimated 150 to 200 ml of blood, was noted in the left temporal region. This hematoma had produced flattening of the convexity of the cerebral cortex in the temporoparietal region on the left. The gyri of the brain were generally flattened and the sulci were narrowed. The subdural hematoma undoubtedly originated from venous bleeding as a result of a contrecoup type of injury. There was a slight shift of the ventricular system to the right, and the left lateral ventricle was partially collapsed.

The subdural membrane consisted of fibrous connective tissue containing numerous thin-walled vascular spaces (fig. 1). The degeneration of blood within such a hematoma leads to an increase in osmotic pressure and thus tends to increase the size of the hematoma. The stretching of the subdural membrane may then lead to rupture of the thin-walled vessels within the membrane, with the result that there is a progressive increase in the size of the subdural hematoma.

The bronchi were filled with debris containing numerous neutrophil leukocytes, but there was very little inflammatory infiltration in the lung tissues. The previously described nodules in the apexes of the lungs were fibrocalcific, and special stains of this tissue failed to reveal any mycotic or bacterial agent. The lung sections also showed foci of atelectasis. In areas, this was complete while in other areas the alveoli were small and rounded.

The sections of the stomach ulcers showed areas of complete destruction of the mucosa. The surfaces of the ulcers were covered by necrotic debris and the underlying tissues were infiltrated by numerous phagocytes, lymphocytes, and plasma cells. There was no fibrous tissue proliferation or cicatrization. These ulcers were, therefore, acute and were probably due to either intracranial disturbances or to a stress reaction.

Multiple sections of dorsal and ventral spinal roots and spinal ganglia (figs. 2 and 3), showed an infiltration of these structures by lymphocytes, histiocytes, and plasma cells. The myelin sheaths were swollen and, in many instances, had a bubbly appearance. Phagocytes were associated with distorted myelin sheaths in many areas.

The findings in the nervous system are those which have been described in acute idiopathic polyneuritis.[3] This condition is commonly called Guillain-Barré syndrome due to the fact that Guillain and Barré stressed the albumino-cytologic disassociation which is present in the spinal fluid in this condition. Swelling, tortuosity, and fragmentation of axis cylinders, sometimes described in this syndrome, were not prominent in this case.

In the myocardium, there was a focal infiltrate consisting predominantly of histiocytes but also containing plasma cells and lympho-

Figure 1. Photomicrograph of membrane of subdural hematoma showing partially intact erythrocytes on inner surface of membrane and thin-walled vascular spaces within the membrane. (× 100) *(Courtesy of the U. S. Army 406th Medical General Laboratory)*

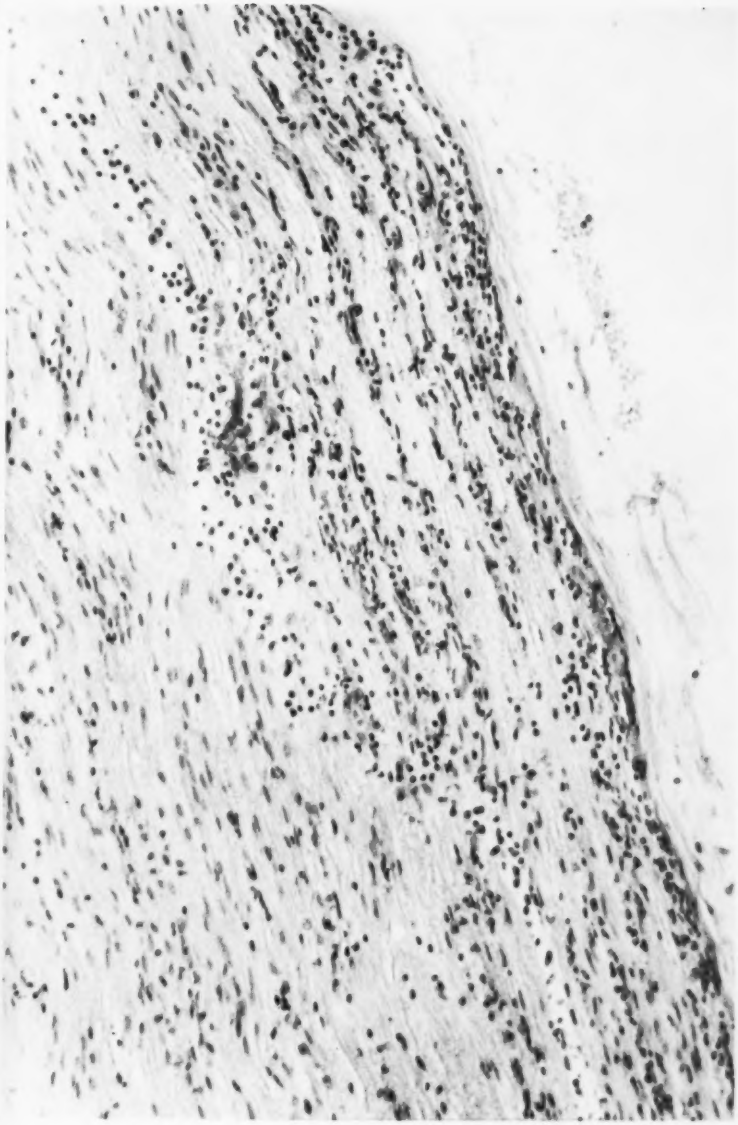

Figure 2. Section of dorsal spinal root showing myelin degeneration and infiltration of inflammatory cells. (× 100) (Courtesy of the U. S. Army 406th Medical General Laboratory)

Figure 3. Higher magnification of dorsal spinal root showing alterations in myelin sheaths and inflammatory infiltration of nerve. (× 400) *(Courtesy of the U. S. Army 406th Medical General Laboratory)*

cytes. This finding also has been described in acute idiopathic polyneuritis.

Pathologic diagnoses:

1. Acute idiopathic polyneuritis
2. Subdural hematoma, left temperoparietal area
3. Fracture, simple, complete, right temporal bone
4. Contusion, temporal muscle, right
5. Gastric ulcers, acute
6. Bronchopneumonia, terminal, acute
7. Atelectasis, bilateral, partial, due to mucous obstruction of bronchi
8. Malaria (a diagnosis on basis of clinical history only)
9. Arteriosclerosis, coronary arteries, moderate

COMMENT

Doctor Dozier: At this time, I believe, it is well to consider the possible relationships between the various findings noted in this patient. Whether or not the malaria was related to the other findings must, I am afraid, remain conjectural. There have been reports of cases of Guillain-Barré syndrome following fever therapy for gonorrhea.[4] Whether fever may, in instances, bear a relationship to this syndrome similar to the relationship of fever and herpes simplex is certainly debatable.

The relationship of skull fracture and the subdural hematoma to the acute idiopathic polyneuritis seems more definite. In medical school many of us were told of a man who fell down a stairway sustaining a broken leg, and who on complete examination, was found to have diphtheria. In that case, the fall occurred because the individual was already ill; the injury was apparent while the disease was inapparent. In our case, we have an apparent disease and an inapparent injury. Weakness of the lower extremities is an early symptom of Guillain-Barré syndrome and falls during this stage of the disease are easily sustained. The slight atelectasis, plugging of bronchi with mucus, and early bronchopneumonia appear to be related to the paralysis with absence of coughing and consequent poor bronchial drainage.

The cause of acute idiopathic polyneuritis is not completely understood. It may well be a syndrome of multiple etiologic factors with a pathologic condition representing a reaction common to injury by a variety of agents. Edema of the nerves at the point of their exit from the bony confines of the central nervous system has been suggested as a factor in the pathogenesis of the disease. A virus etiology has been repeatedly considered, but all attempts at virus isolation, including those made in this case, have thus far failed. Waksman and Adams[5] reported the experimental production of a syndrome in rabbits morphologically and clinically resembling Guillain-Barré syndrome. They accomplished this by injecting homologous and heterologous sciatic-nerve extracts with an adjuvant. A case of Guillain-Barré

syndrome following smallpox vaccination was reported recently and there are reports of the syndrome following the administration of antirabic serum, typhoid-paratyphoid vaccine, tetanus antitoxin, pertussis vaccine, antipneumococcic vaccines, human serum, and para-aminosalicylic acid.[6] These reports have led to the strong argument for an immunologic origin for this disease but there is. at present, certainly nothing definite about the cause of this syndrome.

Doctor McDowell: This has been a most interesting and provocative case. I would like to ask our neurosurgeon to comment on the unexpected findings here.

Doctor Hoessly:* First of all, I wish to state that I did not see this patient. It is hard to tell in retrospect, but if we didn't have the autopsy findings, a lot of the symptoms could have been attributed to acute idiopathic polyneuritis. There were no headaches and no papilledema. It is probable that the subdural hematoma would have had to be more massive to lead to death by itself. Intracranial pressure was not very high—168 mm of saline—which is normal. The history is not typical of a massive subdural hematoma—no trauma was known. This case shows the importance of having a *complete* autopsy. If you hadn't gone on to section the ganglia and spinal roots, somebody might have attributed the entire clinical picture to subdural hematoma. We must conclude that the man had two independent diseases.

Doctor Zeller: Yes, the complete autopsy is essential to the argument for two diseases—the subdural hematoma alone could have adequately explained the elevated spinal fluid protein.

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Near-Fatal Anaphylaxis From Typhus Vaccine

R. LEWIS WRIGHT, *Lieutenant, MC, USNR*

THE so-called anaphylactic reaction in animals that can follow repeated administrations of a foreign protein has been known for several decades. The exact pathophysiology of this reaction is still not completely understood. For years physiologists have induced such responses in lower animals for both experimental and demonstration purposes. These reactions rarely have been seen in man. Formerly they occasionally were seen following administration of various antiserums or antitoxins containing horse serum or other proteins of animal origin. Within the past 15 years these serums have been used less frequently, but such reactions have been noted following injections of newer preparations such as penicillin and vaccines prepared by egg-yolk sac or embryo culture methods.

CASE REPORT

A 33-year-old white man was admitted to sick bay on the U. S. S. *Northampton* on 6 February 1958, complaining of a skin rash and itching. Fifteen minutes earlier he had received a 1-ml booster subcutaneous injection of typhus vaccine inasmuch as the ship was en route to Europe. Since early childhood, ingestion of eggs had been followed by nausea and vomiting. The patient had always taken the recommended vaccines despite a warning that certain ones were not recommended for egg-sensitized individuals. He had received typhus vaccine on four previous occasions (1950-1956), three injections of yellow fever vaccine (1943-1953), and two of influenza vaccine (1955 and 1956) with no untoward effect.

On admission there was extensive generalized urticaria. The patient was alert, co-operative, and was complaining of intense pruritus. An injection of 50 mg of Benadryl (brand of diphenhydramine hydrochloride) was given intravenously. Following this a capsule containing 50 mg of the same drug was given by mouth. There was dramatic immediate relief of pruritus and regression of the urticaria. Within a few minutes the patient became drowsy and wanted to lie down. This was attributed to the sedative effect of the antihistamine. For over an hour he slept quietly and all seemed well until audible laryngeal stridor appeared. On uncovering the patient, fasciculations were noted in the

From U. S. S. *Northampton*, FPO, New York, N. Y.

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muscles of all extremities and his spine was in a position of hyperextension. Attempts to rouse him were unsuccessful. At this time his pulse rate was 134 per minute; respirations, 8 per minute and labored; and blood pressure, 80/? mm Hg. Auscultation of the chest revealed coarse wet rales throughout both phases of respiration. A 0.5 ml injection of epinephrine, 1:1000, was given subcutaneously. For 10 minutes there was no apparent change and the patient appeared moribund. As a small intravenous dose of epinephrine was being prepared his stridor became less marked, respiratory rate increased to 12 per minute, and his blood pressure rose to 90/70 mm Hg. The patient remained in a state of hyperextension but began to respond somewhat incoherently to simple commands. Another subcutaneous injection of epinephrine was given 20 minutes after the first one. Within the next half-hour he improved rapidly and vital signs reverted to normal, with the exception of a persistent tachycardia of about 110 per minute. Because of the severity of the allergic reaction and initial transient improvement with the antihistamine, followed by an exacerbation of the anaphylaxis, it was elected to begin steroid therapy. Cortisone, 150 mg, was given intramuscularly for three days and later in gradually decreasing amounts until it was discontinued. For several days the patient complained of soreness in the cervical and lumbar paravertebral muscles but this gradually subsided and the remainder of his convalescence was uneventful. At the time of this writing, 10 months later, he remains in good health.

COMMENT

Present-day typhus vaccine is prepared according to the method of Cox[1] and contains a killed suspension of *Rickettsia prowazeki* grown on the yolk sac membrane of the chick. Conceivably, an allergic reaction to such a vaccine might be caused by sensitization to either the rickettsial bodies or to yolk sac fragments. Cox[2] believes the latter to be more likely. Clinical evidence is in accord with this conclusion as each of the reported cases of anaphylaxis from typhus vaccine occurred in an individual who was allergic to egg yolk.[2-6]

The case reported here is interesting and unique in several respects. It occurred in a patient who had received typhus vaccine previously. The other patients developed anaphylactic reactions following their first injections of the vaccine. It is probable that the early intravenous administration of Benadryl delayed the reaction. The reaction reached its peak in about 90 minutes; in previously reported cases, the reaction occurred in from a few seconds to 30 minutes with one exception.[7] In retrospect, perhaps it would have been wise to have administered epinephrine initially. At that time, however, urticaria was the only allergic manifestation and it disappeared promptly after the intravenous injection of the antihistamine.

SUMMARY

A case of severe anaphylaxis following subcutaneous administration of typhus vaccine is reported. This occurred in a patient

with a long history of allergy to eggs who had received multiple previous injections of egg-prepared vaccines with no ill effects. Review of the literature shows that less than 12 similar cases have been reported. Of these, two have been fatal.[6-8] It cannot be emphasized too strongly that egg-prepared vaccines should not be given to persons with a suspected allergy to eggs and that, wherever and whenever such vaccines are given, appropriate emergency drugs such as epinephrine or the antihistamines should be available immediately.

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7. Sprague, H. B., and Barnard, J. H.: Egg allergy; significance in typhus and yellow fever immunization. *U. S. Nav. M. Bull.* 45: 71-74, July 1945.

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PROGRESS IN PSYCHIATRY

Dramatic developments have occurred in American psychiatry in the past five decades. Advances in dynamic psychiatry, individual psychotherapy, group psychotherapy, administrative techniques, and architecture and the advent of professional adjunctive services have contributed tremendously to the prevention and cure of psychiatric illness. Early intensive treatment results in the recovery of patients previously considered to be incurable. At the turn of the century the practice of psychiatry consisted primarily in the philosophical contemplation of nervous and mental disease. The psychiatric hospital, private or public, was, in fact, a place where the mentally ill patient could seek asylum from a nonsympathetic public. Today it need no longer be true that the psychiatric hospital is simply a warehouse for the bodies of psychiatrically ill people.—Perry C. Talkington: Psychiatry in Texas (editorial), *Texas State Journal of Medicine*, November 1958.

DEPARTMENTS

AMA MILITARY MEDICINE SECTION PRESENTS ANNUAL PROGRAM, ATLANTIC CITY, 9-11 JUNE

The program of the Section on Military Medicine promises to be an outstanding feature of the annual meeting of the American Medical Association in Atlantic City during the second week in June, according to Rear Admiral Alphonse McMahon, MC, USNR (Ret.), associate professor of medicine at St. Louis University School of Medicine, chairman for 1958-1959. The section will meet in the afternoon on 9, 10, and 11 June in Room A of Convention Hall.

A unique presentation in the program will be an original three-act dramatization of events which might occur if the United States sustained a major nuclear weapons attack. Three other audio-visual presentations will be devoted to biodynamics research in the Air Force, practice of medicine in the antarctic, and problems of chronic cold exposure. Dr. Frank B. Berry, Assistant Secretary of Defense (Health and Medical) will report on the activities of his office and Brig. Gen. Floyd L. Wergeland, MC, USA, will discuss Medicare. The program will open with a symposium on medicine in the jet and space age.

Admiral McMahon

Captain Schultz

Colonel Bramlitt

In addition to Admiral McMahon, the officers of the section are Major George H. Houck, MC, USAR, Palo Alto, Calif., vice chairman; Col. Charles H. Bramlitt, USAF (MC), Washington, D. C., secretary; Col. Charles L. Leedham, MC, USA (Ret.), Cleveland, Ohio, delegate; and Captain Robert V. Schultz, MC, USN, Washington, D. C., representative to AMA scientific exhibit. The military departments will award retirement point credits to reserve Medical Corps officers on inactive status who attend the meeting. The complete program follows:

Tuesday, 9 June 1959—1:15 p. m.

Business meeting (election of officers)

Symposium on Medical Problems in the Jet and Space Age—*Brig. Gen. Donald D. Flickinger, USAF (MC),* Surgeon and Director of Life Sciences, Air Research and Development Command, Andrews Air Force Base, Washington, D. C., moderator.

The Impact of Space Exploration on Biology and Medicine—*W. Randolph Lovelace, II, M. D.,* Director, Lovelace Foundation for Medical Education and Research, Albuquerque, New Mex.

Physiological Aspects of Hyper and Hypogravic States—*Capt. Julian E. Ward, USAF (MC),* Chief, Biomedical Division, Air Force Ballistic Missile Division, Air Research and Development Command, Inglewood, Calif.

Medical Aspects of Space Ambient Radiations of Extraterrestrial Space—*Col. Paul A. Campbell, USAF (MC),* Chief, Space Medicine Division, U. S. Air Force School of Aviation Medicine, Randolph Air Force Base, Tex.

Life Support Systems for Space Vehicles—*Lt. Col. Stanley White, USAF (MC),* National Aeronautics and Space Administration, Langley Research Center, Va.

Medical Criteria in Space Crew Selection—*Capt. George E. Ruff, USAF (MC),* Chief, Stress and Fatigue Section, Aero Medical Laboratory, Wright-Patterson Air Force Base, Ohio.

Medical Investigation Following Overseas Civil Airline Accident—*Capt. William M. Crafft, MC, USN,* U. S. Naval School of Aviation Medicine, Pensacola, Fla.

Military Disability Retirement Problems for Regular and Reserve Officers—*Col. Walter H. Moursund, Jr., MC, USA,* Chief, Physical Standards Branch, Office of The Surgeon General, Department of the Army, Washington, D. C. Discussed by *Col. Russell S. Leone, USAF (MC),* Chief, Physical Standards Division, Office of The Surgeon General, Department of the Air Force, Washington, D. C.; and *Capt. E. E. Hogan, MC, USN,* Director, Physical Qualifications and Medical Records Division, Bureau of Medicine and Surgery Department of the Navy, Washington, D. C.

Medicare—*Brig. Gen. Floyd L. Wergeland, MC, USA,* Executive Director, Office for Dependents' Medical Care, Washington, D. C.

Activities of the Office of the Assistant Secretary of Defense (Health and Medical) During the Past Year—*Frank B. Berry, M. D.,* Assistant Secretary of Defense (Health and Medical), Washington, D. C.

Wednesday, 10 June 1959—1:30 p. m.

Chairman's Address—Communication: A New Challenge—*Rear Adm. Alphonse McMahon, MC, USNR (Ret.),* St. Louis University School of Medicine.

"Strike"—An Audio-Visual Presentation in Three Acts. *Brig. Gen. Harold C. Lueth, MC, USAR,* Evanston, Ill., moderator.

ACT I. Reveille—Before, and a few hours after.

Panelists: *Col. Albert J. Glass, MC, USA,* Chief, Psychiatry Consultant, Office of The Surgeon General, Department of the Army; Washington, D. C.; *Waltman Walters, M. D.,* Mayo Clinic, Rochester, Minn.; and *Col. John R. Hall, MC, USA,* Fort Lesley J. McNair, Washington, D. C.

ACT II. Fatigue—The next few days.

Panelists: *Rear Adm. Wendel G. Scott, MC, USNR,* Saint Louis, Mo.; *Lt. Col. James B. Hartgering, MC, USA,* Division of Nuclear

Medicine, Walter Reed Army Institute of Research, Washington, D. C.; and *Lt. Col. Gene W. Crowell, USAF (MSC),* Chief, Programs Branch, Office of The Surgeon General, Department of the Air Force, Washington, D. C.

ACT III. Taps—Much later.

Panelists: *Col. Robert L. Hullinghorst, MC, USA,* Research and Development Command, Office of The Surgeon General, Department of the Army, Washington, D. C.; *Brig. Gen. Richard L. Meiling, AFRes (MC) (Ret.),* Associate Director, The Health Center, Ohio State University, Columbus, Ohio; *Maj. Charles C. Pixley, MC, USA,* Army Medical Services School, Fort Sam Houston, Tex.; and *Col. James T. McGibony, MC, USA,* Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D. C., panelists.

Thursday, 11 June 1959—1:15 p. m.

Some Aspects of Air Force Biodynamics Research—*Col. John P. Stapp, USAF (MC)* Chief, Aero Medical Laboratory, Wright-Patterson Air Force Base, Ohio; *Capt. Edward L. Brown, USAF,* Chief, Crew Station Section, Aero Medical Laboratory, Wright-Patterson Air Force Base, Ohio; and *Capt. Eli Beeding, USAF (MSC),* Biodynamics Branch, Aero Medical Field Laboratory, Holloman Air Force Base, New Mex.

Practice of Medicine in the Antarctic

Trauma and Surgical Aspects of Medical Care in an Isolated Cold Weather Environment—*Joel Drabkin, M. D.,* U. S. Naval Air Station, Quonset Point, R. I.

Medical Considerations in the Selection of Personnel to Live in an Isolated Cold Environment—*Howard C. Taylor, III, M. D.,* New Haven, Conn.

General Medical Problems of Cold Weather Practice and Chronic Cold Exposure—*Pat B. Unger, M. D.,* Chapel Hill, N. C.

Man's Survival in a Cold Environment—The Physiology and Anatomy of of Cold Weather Medicine—*Bryan C. Dalton, M. D.,* Brookline, Mass.

Psychiatric Problems of Extreme Isolation in the Antarctic—*Charles S. Mullin, Jr., M. D.,* U. S. Naval Hospital, Philadelphia, Pa.

MILITARY PANEL ON OPTOMETRIC EXAMINATION

A panel on "Factors in Developing a Minimum Optometric Examination for Military Personnel," will be presented at the 62d Annual Congress of The American Optometric Association, Statler Hilton Hotel, Dallas, Texas, 28 June through 1 July 1959. Participants will include Major D. Russell Reed, MSC, USAR, Captain Lester R. Loper, USAF (MSC), Commander Robert L. Henry, MSC, USN, and Lieutenant Colonel John W. Sheridan, MSC, USA. On the last day of the meeting a symposium on "Medical Service Corps Trends," will be presented by the chiefs of the three Medical Service Corps, Colonel Bernard Aabel, MSC, USA, Captain Leo J. Elsasser, MSC, USN, and Colonel Leonard P. Zagelow, USAF (MSC).

MAN IN SPACE. Major General Oliver K. Niess, USAF (MC), Air Force surgeon general, is literally floating in space during a weightlessness experiment in a C-131 aircraft. Colonel John P. Stapp, USAF (MC), chief of the Aero Medical Laboratory at Wright Air Force Base, Ohio, where the flight was made in the specially modified Convair transport, is in the background. Maximum duration of the total absence from the normal pull of the earth's gravitational force during these flights was 15 seconds. During orbit around the earth or in free space, flight space crews are expected to remain weightless for periods ranging from hours to months, or even years.

COMDR. KEENER HONORED BY WIVES' WING

Lieutenant Commander Mary F. Keener, MSC, USN, an aviation physiologist stationed at the U. S. Naval Air Station, Barbers Point, T. H., has been selected for honorary membership in the Wives' Wing of the Aero Medical Association for her contributions to aviation medicine. The award will be made at a luncheon of the ladies' auxiliary of the Association on 28 April during the thirtieth annual meeting at the Statler Hilton Hotel, Los Angeles. Commander Keener, a native of Attala, Alabama, is credited with having instructed more naval aviation personnel in the use of oxygen equipment, night vision, ejection seat procedures, and low pressure chamber indoctrination than any other aviation physiologist. She is a graduate of the University of Alabama and has been on active duty since January 1942.

MAJOR BERREY HEADS PEDIATRICS COMMITTEE

The first tri-service committee on military pediatrics has been established recently by the executive board of The American Academy of Pediatrics. Major Bedford H. Berrey, MC, USA, Office of Dependents' Medicare, Washington, D. C., has been named committee chairman. Members of the committee are Captain William I. Neikirk, MC, USN, chief of pediatrics service, U. S. Naval Hospital, Philadelphia, Pa., Commander Frederick B. Becker, MC, USN, assistant chief of pediatrics service, U. S. Naval Hospital, Portsmouth, Va., and Major Thomas M. Holcomb, USAF (MC), chief of pediatrics service, U. S. Air Force Hospital, Lackland Air Force Base, San Antonio, Tex. The committee's scope includes the fostering of high standards of pediatric training through liaison with the respective surgeons general and The Academy of Pediatrics, stimulating study and research into the practice of pediatrics, especially in the uniformed services. A meeting of the new committee will be held during the annual session of the Academy of Pediatrics in Chicago, Ill., 5-8 October 1959. Medical officers specializing in pediatrics are invited to attend.

Major Berrey

DR. MIDDLETON REAPPOINTED VA CHIEF

Dr. William S. Middleton, an honorary colonel in the U. S. Army Reserve, has been reappointed chief medical director of the Veterans Administration for a second four-year term effective 1 March 1959. Formerly dean of the University of Wisconsin Medical School and a veteran of both World Wars, he heads the VA's 171 hospitals, nearly 100 outpatient clinics and home-town medical services, which provide care for more than 2½ million patients yearly.

MEND SYMPOSIA HELD IN MARCH AND APRIL

Faculty members of medical schools participating in the program of Medical Education for National Defense (MEND) attended a symposium on "Medical Operations and Research in Climatic and Environmental Extremes" at the U. S. Naval Medical School, Bethesda, Md., 4-6 March. Another MEND symposium, under Air Force sponsorship, is scheduled at the Aero Medical Laboratory, Wright-Patterson Air Force Base, Ohio, 8-10 April. Captain Bennett F. Avery, MC, USN, is national co-ordinator of MEND.

CEREMONY. Dr. Frank B. Berry, Assistant Secretary of Defense (Health and Medical) addressed a group of distinguished guests and visitors on 17 December during the groundbreaking ceremony for the new college building of the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D. C. With him on the platform are Lieutenant General George W. Mundy, USAF (left) commandant of the Industrial College, and Major General Emerson C. Itschner, USA, Chief of Engineers, U. S. Army. Dr. Berry, assisted by General Mundy, turned the first shovel of earth at the site of the new building.

REAPPOINTED. Rear Admiral Bartholomew W. Hogan, MC, USN, took the oath of office for reappointment to a two-year term as Surgeon General of the Navy and Chief of the Bureau of Medicine and Surgery during a ceremony on 13 February in the Office of the Secretary of the Navy. Administering the oath is Captain Wilfred A. Hearn, USN, Assistant Judge Advocate General, as the Honorable William B. Franke, Under Secretary of the Navy, looks on.

NAVY PHYSICIAN-PILOT GIVEN DECORATION

Lieutenant Tabor

Lieutenant Richard H. Tabor, MC, USN, has been awarded the Navy Commendation Ribbon with Metal Pendant at the Naval Air Station Oceana, Virginia Beach, Virginia, for his outstanding performance of duty while serving as flight surgeon and test officer on the aviator's full pressure suit project. Subjecting himself to extreme simulated altitudes during a 72-hour period in a low pressure chamber, Lieutenant Tabor was able to determine, observe, and report accurately and objectively the biological effects, incident to this test, providing valuable information relating to the future improvement of the full pressure suit. A naval aviator since 1943, he is a 1952 graduate of the University of Cincinnati College of Medicine. Following completion of an internship at the U. S. Naval Hospital, San Diego, California, he attended the U. S. Naval School of Aviation Medicine at Pensacola, Florida.

CAPT. SCHIFF WINS HARRIS P. MOSHER AWARD

Captain Schiff

Captain Maurice Schiff, MC, USN, head of the eye, ear, nose and throat service at the U. S. Naval Hospital, Oakland, Calif., has been named recipient of the Harris P. Mosher Memorial Award for the best medical thesis submitted to the American Laryngological, Rhinological and Otological Society, and has been elected to active membership of the society. Captain Schiff read his prize-winning paper, "Juvenile Nasopharyngeal Angiofibroma," at the annual program of the society at The Homestead in Hot Springs, Va., on 12 March. In his present assignment since 1955, he also serves on the teaching staff of the University of California Medical Center, San Francisco, Calif.

A Message From the A. M. A.

This is the second and concluding part of a report on the results of a continuing opinion survey of physicians released from active military service. The first part of this report appeared in last month's issue of the *U. S. Armed Forces Medical Journal*. This summary is based on 1,167 returns received in 1957. A total of 2,055 questionnaires were distributed by the Council on National Defense of the American Medical Association.

Physicians' Evaluation of Staffing Conditions. One of the questions was designed to obtain the opinion of physicians as to staffing conditions of nurses, enlisted medical personnel, physicians, dentists, and others at the two units where the physician served his longest and next longest assignments. With respect to the longest assignment, the tabulation of this multiple-answer question revealed that in the Army replies indicating overstaffing totaled 160; understaffing 339; and adequate staffing, 690. In the Navy, overstaffing totaled 165; understaffing, 239; and adequate staffing, 615. The Air Force tabulation revealed 314 replies indicating overstaffing; 749 of understaffing; and 1,157 of adequate staffing.

The response to the question concerning the next longest assignment showed that in the Army, overstaffing totaled 78; understaffing, 126; and adequate staffing, 429. In the Navy the results were 84, 115, and 407, respectively, while the Air Force tabulation was 106, 205, and 510, respectively.

Physician overstaffing in the Navy and dentist overstaffing in the Army and Air Force predominated in regard to the longest assignment. Physician overstaffing led in the Army and Navy and dentist overstaffing led in the Air Force with respect to the next longest assignment. On the longest assignment enlisted medical personnel and dentists were second and third, respectively, in regard to overstaffing in the Navy, while physicians and enlisted medical personnel were second and third in both the Army and the Air Force. On the next longest assignment dentists and enlisted medical personnel were second and third, respectively, in the Army, while enlisted medical personnel and dentists were second and third, in the Navy. In the Air Force physicians and enlisted medical personnel were second and third, respectively, as to overstaffing, on the next longest assignment.

From the Council on National Defense of the American Medical Association. The views and opinions expressed are not necessarily those of the Department of Defense. —*Editor*

Unnecessary Aspects of Military Training. There were 334 physicians who responded affirmatively to the question, "Were there any aspects of your military training that were unnecessary or wasted?" Negative answers were received from 833 medical officers. With respect to the affirmative replies, the most frequently mentioned area of waste was the performance of non-medical duties. In the Army, 30 per cent of those who responded affirmatively were of that opinion, as were 23 per cent of those in the Navy and 42 per cent of those in the Air Force.

Making Military Service More Attractive. A total of 1,051 physicians offered suggestions for making military service more attractive to physicians. Only 110 physicians thought that nothing could be done to make military service more attractive to medical men. In the 1956 survey, the number one suggestion was a recommended improvement in the utilization of medical personnel, while the 1957 survey reveals a recommended increase in pay as the most frequent suggestion for making military service more attractive to medical men. The 1956 number one suggestion, as well as a recommendation of adequate family housing, did not appear as one of the top ten suggestions in the results of the 1957 survey. Choice of stable location was the second most frequent suggestion from physicians in all branches. Less administrative non-medical duties was third as the suggestion of Army and Navy physicians, while more capable commanding officers was third for the Air Force.

Improvement of Services to Military Physicians by Medical Associations. A total of 397 physicians (34 per cent) offered suggestions in response to the question concerning the role of national and local medical associations in maintaining closer contact or rendering better service to their members who served as physicians in the Armed Forces. Some physicians offered more than one suggestion. The other 770 physicians who returned the questionnaire offered no suggestions. The most frequently suggested improvements in service were: (1) more personal visits by civilian physicians to evaluate grievances, (2) more invitations to military physicians to civilian medical meetings, and (3) the dissemination of more information to military physicians.

Physicians Who Would Voluntarily Remain in Service. In response to the question relative to military service beyond the obligatory tour of duty, 675 physicians indicated they would not be willing to stay in military service for more than two years under any conditions except total war. There were 492 physicians who said they would serve an additional period under certain conditions. Some physicians listed more than one condition. The most frequently listed condition was "increase in pay," followed by choice of stable location, choice of duty assignment, and opportunity for residency or further training.

Preferred Branch of Service for Practice of Medicine. In response to the question of preference if the physician were going to practice medicine in a Federal Government Agency, 453 physicians stated a preference for the Armed Forces. A total of 436 physicians expressed a preference for other agencies of the Federal Government, while 248 physicians had no preference and 30 did not answer this question. Of those who preferred the Armed Forces, the majority chose the branch of service in which they had served.

Distribution by Rank at Time of Discharge. The majority of physicians in the Army and Air Force held the rank of captain at the time of their release from active military duty, while those separated from the Navy held the equivalent rank of lieutenant, senior grade. The 1956 survey revealed that the majority of Navy physicians held the rank of lieutenant, junior grade, at the time of separation. There were 1,102 physicians who answered this question. The 1957 survey indicated that approximately 2 per cent of those who reported were in the lowest rank, while 85 per cent held the rank of captain (Army or Air Force) or lieutenant, senior grade (Navy). There were approximately 13 per cent with the rank of major or lieutenant commander, and higher.

Length of Active Service as Medical Officer. In the Army, 308 responding physicians served an average (median) of 23 months in the United States, and 152 responding physicians served an average (median) of 21 months at overseas stations. There were 279 Navy medical officers who had an average (median) of 24 months active duty in the United States, and 108 Navy medical officers had an average (median) of 12 months overseas. Responses from 545 physicians in the Air Force revealed an average (median) tour of duty of 24 months in the United States. The average (median) tour of duty at overseas bases for 194 physicians in the Air Force was 22 months.

Reserve Status. Of the 1,167 physicians reporting, 193 said they retained their reserve commissions, while 972 resigned their commissions. There were 2 who did not respond. By services, the Army had 68 retaining commissions and 247 resigning; the Navy had 44 retaining and 236 resigning; and the Air Force had 81 retaining and 489 resigning their commissions.

OFFICIAL DECORATIONS

The following awards were recently announced by the Department of the Air Force.

Legion of Merit

Jack C. Carmichael, Col., USAF (MSC)
Charles B. S. Evans, Col., AFRes (MC)
George M. Knauf, Col., USAF (MC)

Officers Certified by Specialty Boards

The surgeons general of the military medical services have announced that the following regular Medical Corps officers have been certified by the boards indicated.

American Board of Orthopedic Surgery

Dunckel, William C., Jr., Maj., USA
MacDonald, William F., Lt. Col., USA
Omer, George E., Jr., Maj., USA
Phippen, William G., Maj., USA
Sundre, Robert L., Maj., USA
Woodard, George S., Jr., Maj., USA

American Board of Pathology

Pathologic Anatomy

Jaffurs, William J., Capt., USA
Ray, John P., Jr., Capt., USA
Sulak, Michael H., Maj., USA
White, David C., Maj., USA
Wilhite, Glenn E., Capt., USAF

American Board of Radiology

Dunnagan, William A., Capt., USAF
Springer, Roy A., Capt., USAF
Thomas, Martin A., Capt., USAF

Nuclear Medicine

Cowgill, Herbert F., Maj., USA
Knox, Gaylord S., Capt., USA

American Board of Surgery

Andrew, Samuel E., Lt. Col., USAF
Glew, Donald H., Jr., Maj., USA
McKeen, Charles L., Maj., USAF
Pope, James K., Maj., USA

Deaths

MITCHELL, Barbara Rae, Lieutenant, NC, USNR, of Omaha, Nebr.; en route to U. S. Naval Hospital, Guam, M. I., for duty; graduated in 1950 from Loyola School of Nursing (Saint Anne's Hospital), Chicago, Ill.; appointed an ensign in the United States Naval Reserve. Reported for active duty on 20 July 1951; released from active duty on 19 July 1953. Returned to active duty on 1 March 1957 with rank of lieutenant (junior grade); died 15 January 1959; aged 29, in Altamount, Calif., of burns.

MOSELEY, Harry Gladding, Colonel, USAF (MC), of Denver, Colo.; assigned to 1002d Inspector General Group, Norton Air Force Base, Calif.; graduated in 1938 from Washington University School of Medicine, St. Louis, Mo.; appointed a first lieutenant in the Army of the United States 7 June 1938; reported for active duty 5 July 1939; commissioned a first lieutenant in the United States Army on 14 February 1940; transferred to the United States Air Force on 1 July 1949; died 10 February 1959; aged 51, near Norton Air Force Base, Calif., in a military aircraft accident.

TOEWS, Suzanne W., Lieutenant, NC, USNR, Minneapolis, Minn.; en route to U. S. Naval Hospital, Guam, M. I. for duty; graduated in 1946 from Samaritan Hospital School of Nursing, Nampa, Idaho; appointed a lieutenant in the United States Naval Reserve and reported for active duty on 30 June 1955; died 6 February 1959; aged 40, at Tripler Army Hospital, Honolulu, T. H., of encephalomalacia due to thrombosis.

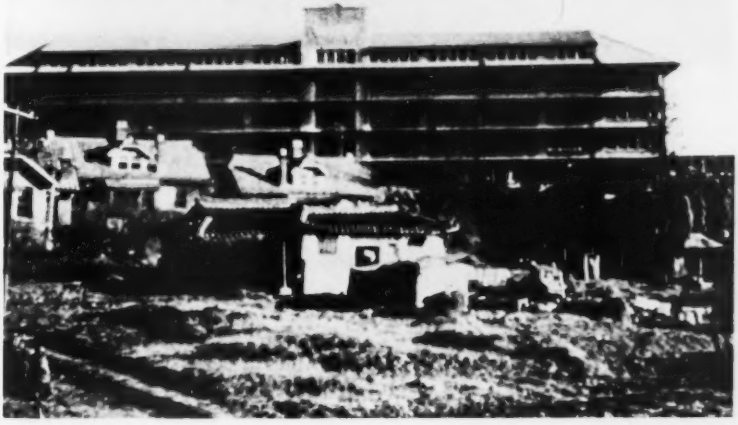
CORRESPONDENCE

Dr. Frank B. Berry
Assistant Secretary of Defense (Health and Medical)

Dear Dr. Berry:

Enclosed is a photograph of the Eighth Army Chest Memorial Hospital in Seoul, Korea, and also a picture showing General Maxwell Taylor visiting the hospital. You may recall that Brigadier General Floyd Wergeland gave me a copy of these pictures that Dr. Weiss, head of the Mission at Severance University, sent to him several days ago. You indicated your interest in that you thought it might be suitable to have these printed in the *Armed Forces Medical Journal.* The following brief story as to how this came about may be of some interest, and although I am sure I do not know all of the factors involved, I am reasonably sure of the following:

Early in 1954, at the request of Major General Earle Standlee, I went to Korea with the thought of making a study and analysis of the possibility of handling some of the problems, at least, related to the



The Eighth United States Army Chest Memorial Hospital, Seoul, Korea.

tremendous tuberculosis problem among the Koreans. At that time, as you may recall, the war had come to a standstill and there was a great deal of military equipment that was becoming available and might continue to do so if the war did not flame anew. A rather extensively planned proposal was presented to utilize a great deal of this equipment and encourage its use in the care of patients with tuberculosis. Actually, this plan was, I am sure, far too great to implement at that time; however, within the course of the next few months the President

of the United States made available to the Eighth Army Commander in Korea an appreciable sum of money—some 15 million dollars—to help in the rehabilitation of Korea. It was not permitted to spend this money for the actual labor involved in the building of any structure, but materials could be purchased.

Along about this time, Major General Paul Robinson came to Korea and was named the Eighth Army Surgeon. General Taylor was then the Eighth Army Commander and he was looking for recommendations which would result in a suitable memorial to the Eighth Army. The

From left to right: Dr. George Paik, President, Yow Sei University, Seoul; General Maxwell D. Taylor, Chief of Staff, U. S. Army; Dr. Ernest W. Weiss, Medical Missionary, Methodist Mission, Seoul; General George H. Decker, Commanding General, Headquarters 8th U. S. Army, Seoul; Lt. General Robert M. Cannon, Deputy Commander-in-Chief, U. S. Army Pacific; and Dr. Y. S. Lee, Superintendent, Severance Hospital, Seoul, Korea.

idea of a chest hospital as a memorial to the Eighth Army in Korea was presented to him. General Taylor accepted the proposal and made available about $500,000 including some $100,000 for the equipment of the operating room suite. That money was turned over to the Mission which Dr. Weiss, an American physician, heads in Seoul. This Mission then added to that sum approximately $250,000 for the labor and furnished a trained architect to work with the Army engineers. I understand that the building is now completed. . . .

Many people in the Eighth Army, early in 1954 or thereabouts, did a great deal to make this hospital possible in that there was only a short time available to accept and obligate the funds. The Mission, I think, did a very fine thing to get a quarter of a million dollars from their home office on a very short notice, and I am sure the Eighth Army has continued to manifest considerable interest in this project. . . .

JAMES H. FORSEE
Brigadier General, MC, USA
Walter Reed Army Hospital
Washington, D. C.

Book Reviews

MEDICAL DEPARTMENT, UNITED STATES ARMY, PREVENTIVE MEDICINE IN WORLD WAR II. Communicable Diseases-Transmitted Chiefly Through Respiratory and Alimentary Tracts. Volume IV. Prepared and published under the direction of Major General S. B. Hays, The Surgeon General, United States Army. Editor-in-Chief: Colonel *John Boyd Coates, Jr.*, MC, USA. 544 pages; illustrated. U. S. Government Printing Office, Washington 25, D. C., 1958. Price $5.50.

From Cicero to Winston Churchill it has been said that to look ahead one must first look back. History thus becomes one of the most practical of all studies and certainly sound planning for the future can only be based on a knowledge of past mistakes and successes. It has therefore been sound medical statesmanship to maintain such historical studies as this and a permanent medical historical unit to make them. This volume is a good example of the value of such studies. In it there has been collected and subjected to analysis a vast amount of information indispensable for future planning as well as a source of information for historians. The book is very complete in covering the infectious diseases of the respiratory and gastrointestinal systems. Emphasis has been placed on their prevalence both at home and in the various war theaters, and on immunization and protective measures. The entire volume is full of information of vital importance to military planning and indeed to civilian preventive medicine. The numerous tables and charts are well designed and present the facts so they can be easily used. The binding, paper, and typography are splendid.

—*LOUIS H. RODDIS, Capt., MC, USN, (Ret.)*

PROGRESS IN NEUROLOGY AND PSYCHIATRY. An Annual Review, Volume XIII, edited by *E. A. Spiegel*, M. D. 611 pages. Grune & Stratton, Inc., New York, N. Y., 1958. Price $12.

A large outpouring of professional medical literature makes it difficult for even the specialist in a relatively narrow field to keep abreast of changing concepts and recent advances in his specialty and its related basic sciences. For this reason there has arisen a need for an annual survey of published literature which endeavors in a single volume to review the most significant or important contributions in this or that clinical specialty. The book under consideration is the thirteenth of an annual review series in neurology and psychiatry. It is an ambitious undertaking of 25 chapters which encompass the published literature in clinical neurology, neurosurgery, psychiatry, and the basic disciplines of neuroanatomy, neurophysiology, neuropathology and neuropharmacology. In general, the editors and contributors have performed their difficult task in a most commendable manner. Approximately 4,000 articles and books are reviewed, some with only one line of comment which gives not much more information than the title of the paper itself, while for others a paragraph or more is devoted which includes the reviewer's critical evaluation. From the standpoint of the clinical neurologist or psychiatrist per-

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haps the major criticism concerns the organization and readability of some of those chapters particularly those devoted to the basic sciences. Here findings of various research reports are given with little or no comment upon their validity or significance. It is uncommon for the average clinician to be sufficiently familiar with methodology and terminology of the newer technics in neurophysiology, neurochemistry, and neuropharmacology so that he can obtain useful information from meager reporting in those fields. Most helpful were those chapters where the reviewer made special efforts to integrate and organize the material with his own comment and evaluation. Despite these shortcomings the book is recommended for neurologists and psychiatrists for it contains a wealth of information relevant to their major areas of interest. However, they should expect to devote considerable time in carefully perusing its contents.

—*ALBERT J. GLASS, Col., MC, USA*

NUTRITION AND ATHEROSCLEROSIS, by *Louis N. Katz*, M. D.; *Jeremiah Stamler*, M. D.; and *Ruth Pick*, M. D., 146 pages; illustrated. Lea & Febiger, Philadelphia, Pa., 1958. Price $5.

The authors begin with the premise that "atherosclerosis is a metabolic disease in which altered cholesterol-lipid-lipoprotein metabolism plays a critical and decisive but not exclusive role." Atherogenic alterations, they believe, are "the consequences of a life-span dietary pattern and result from the ingestion of an habitually unbalanced diet excessive in total calories, total fats, saturated fats and cholesterol, and inadequate in certain essential nutrients, particularly essential fatty acids and amino acids." To support these concepts, the authors use three major investigative approaches to the problem. In the epidemiologic approach they review the extensive studies that have been carried out proving the relationship between diet and atherosclerosis. They contrast the low incidence of coronary heart disease in economically underdeveloped countries and discount any ethnic or racial immunity to atherosclerosis. In the animal-experimental approach to atherosclerosis the authors state that hypercholesterolemia and atherosclerosis has now been produced in all major laboratory animals by giving high-cholesterol, high-fat diets over an extended period. They point out that atherosclerotic plaques produced experimentally in animals fed atherogenic diets can be reversed by substituting low-fat, low-cholesterol feedings. In the section on the clinical pathologic approach to atherosclerosis the authors discuss the controversial ideas on the mechanism of action of unsaturated vegetable and marine oils in reducing serum cholesterol levels. They are of the opinion that none of the current explanations are wholly acceptable. The final chapter of the book deals with a definitive approach to the prophylaxis and therapy of atherosclerosis and is tempered with sound judgment and common sense. The book is highly recommended to all clinicians as an authoritative, well-written, concise treatise in the nutritional aspects of atherosclerosis. —*EMMETT L. KEHOE, Col., MC, USA*

UROLOGY IN GENERAL PRACTICE, by *Frank Coleman Hamm,* M.D., M.S., F.A.C.S., *Sidney R. Weinberg,* M.D., F.A.C.S. 293 pages; illustrated. J. B. Lippincott Company, Philadelphia, Pa., 1958. Price $6.

This book has been used by the authors in the teaching of urology at the University of the State of New York. It is a paperbacked volume and is profusely illustrated with photographs and schematic drawings. It contains an excellent bibliography. Inasmuch as this book is intended for use in teaching basic urology, the authors have omitted controversial points, unlikely theories, and detailed descriptions of major procedures such as are usually found in standard texts on this subject. However, they have described in adequate detail, including illustrations when indicated, all of the aspects of urology, especially diagnostic procedures. The authors have also included an excellent chapter on the roentgenologic aspects of urology, with descriptions of the various procedures employed, as well as photographic reproductions of typical roentgenograms of normal structures and pathologic conditions. This book will be of value to physicians, without specialized urological training, in the management of patients with actual or suspected urological diseases and defects, particularly in the performance of simple diagnostic and minor surgical procedures. It is also recommended for all students, including those at the resident level.

—*MARK S. CURTIS, Capt., MC, USN*

APPLIED MEDICAL LIBRARY PRACTICE, by *Thomas E. Keys,* A.B., M.A., with chapters by *Catherine Kennedy,* B.S., L.S., and *Ruth M. Tews,* B.S., L.S. 495 pages. Charles C Thomas, Publisher, Springfield, Ill., 1958. Price $10.75.

This book by the distinguished medical librarian of the Mayo Clinic, who is also immediate past president of the Medical Library Association, contains both more and less than the average physician cares to know, or needs to know, about medical bibliography. Less, in that only about the first hundred pages bear out the pragmatic promise of the title, and of these only half deal with such matters as the use of medical indexes and abstract publications and the fundamentals of bibliographic description, and all this rather cursorily. More, in that the remainder of the book covers such diverse matters as medical library administration, brief descriptions of "representative" medical libraries in the United States, histories of medical publishing, and rosters of notable private medical libraries, antiquarian book dealers, works available in facsimile editions, and the like. The primary appeal of this book is likely to be to medical librarians, members of medical library committees, medical bibliophiles, and medical historians, in that order.

—*FRANK B. ROGERS, Lt. Col., MC, USA*

BACTERIAL AND MYCOTIC INFECTIONS OF MAN, edited by *Rene J. Dubos,* Ph.D. The Rockefeller Institute. Thirty-six contributors. 3d edition. 820 pages; illustrated. J. B. Lippincott Company, Philadelphia, Pa., 1958. Price $8.50.

The primary value of this volume lies in the exposition of the fundamental processes of infection, and the rationale of control. The editor has contributed a thought-provoking chapter on the evolution and ecology

of microbial diseases, and has addressed himself to the usual but often unappreciated state of peaceful coexistence between parasite and host. Additionally, there are excellent discussions of bacteria indigenous to man, pathogenic properties of bacteria, drug-parasite relationships in vivo, chemotherapy, and epidemiology. Both student and clinician are apt to become lost and discouraged by a wealth of detail more properly directed to the graduate student in bacteriology, and the research worker in the field of infectious disease. It is hard to envisage the busy practitioner giving serious consideration to the detailed composition of culture media, the specific optical rotations of the capsular polysaccharides of the pneumococcus, and the actual number of molecules of antibiotic contained in an individual coccus, of ordinary size, when suspended in a solution containing 0.1μg/ml of penicillin. Errors are few, and for the most part obvious. The caption under figure 19 bears no relationship to the picture above it. There are a few misspellings, and the proprietary name for sulfamethoxypyridazine is erroneously given as Kymex. These are minor points, but they detract from an otherwise splendid volume. A most serious objection, however, can be raised to the system of references appended to many of the chapters, wherein the reader is referred to the second edition of the textbook, for references cited in the text, but not included in the bibliography of the present edition.—*RUSSELL MILLER, Jr., Lt., MC, USN*

A TEXT-BOOK OF ORTHODONTIA, by *Robert H. W. Strang,* M.D., D.D.S., and *Will M. Thompson,* B.S., D.D.S. 4th edition, thoroughly revised. 880 pages; illustrated. Lea & Febiger, Philadelphia, Pa., 1958. Price $20.

This volume has been enlarged and improved over previous editions so that it is more readable and the material is presented with better illustrations. Growth and development of the cranium and face in children, once a dark area in orthodontic knowledge and literature, is well covered and explained by the inclusion of part of the work of Broadbent, Brody, and other investigators of this subject. Cephalometrics is so well covered that its use and advantages may now be enjoyed by the general practitioner of clinical orthodontics. The fabrication, philosophy of mechanics and treatment application of the edgewise arch mechanism is described thoroughly and in detail. Any student interested in any aspect of the edgewise mechanism will find a fund of information to guide and help him. A detailed account is given of office procedure, management, and laboratory technics with various dental and orthodontic materials. Teachers and students of orthodontia will find this volume a most inspiring and helpful addition to their library. The orthodontic profession can be proud that Dr. Robert H. W. Strang has labored so long and well on this excellent book.

—*GEORGE F. BOWDEN, Col., USAF, (DC)*

THE CARE OF THE GERIATRIC PATIENT. *E. V. Cowdry,* editor. 438 pages. The C. V. Mosby Company, St. Louis, Mo., 1958. Price $8.

This book had its inception in a symposium on the care of geriatric patients held in 1955. The first five chapters are based on that symposium and to this 14 additional chapters were added. Contributors include physicians, dentists, nurses and other allied science personnel

who present the medical, surgical, psychiatric, anesthetic, drug therapy, nutritional requirements, genetics and nursing care of the aged, as well as social, economic and rehabilitation problems. In addition, there is a useful chapter with information on organizations and services available in this country. The preface emphasizes the fact that "this book is addressed primarily to the physician in his high calling of guide, philosopher and friend." The emotional, physical, and other differences between older people and persons in the prime of life are set forth, but, more importantly, what can be done today to meet their particular needs is emphasized. This book is recommended to all physicians, whether general practitioner or specialist, who recognize the importance of elder patients and their special problems.

—*JULES J. McNERNEY, Lt. Col., MC, USA*

TREATMENT OF CANCER AND ALLIED DISEASES. Volume 1, edited by *George T. Pack,* M.D., F.A.C.S., and *Irving M. Ariel,* M.D., F.A.C.S. 2d edition. Fifty-five authors. 646 pages; illustrated. Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, N.Y. 1958. Price $22.50.

In this second edition of a well known book, the editors have laidthe cornerstone for a planned series of nine volumes devoted exclusively to the clinical aspects of cancer and its management. If the forthcoming volumes exhibit the meticulous attention to detail shown in the first of the series, this monumental undertaking will easily become the best reference work available in the huge and complex field of cancer diagnosis and therapy. The current volume attempts to present only principles of treatment as they apply to cancer of any type or body region. The chapters proceed logically from cancer prevention and organization of cancer detection facilities, to the pathologic grading of cancer, and on to principles of management including surgery, ionizing radiation and hormonal and chemotherapy. In the sections on therapy, the editors depart from their intention of presenting principles only, for they have accumulated an astounding amount of detail describing the "how", the "when" and the "why". This is especially true of the sections on radiation therapeutics. The inclusion of such detail enhances the value of this volume for most physicians who can now, by reference to appropriate sections, map a detailed and logical course of procedure in the clinical management of their cancer patients. One of the best chapters in a well written book is the one devoted to preoperative and postoperative care. It is simply phrased, concise and enhanced by tables of outstanding value to the text. On the other hand, one wonders why the chapter on electrosurgical treatment, with its emphasis on technical detail of types of currents used, was incorporated into this volume. This book is a must as a reference volume for all physicians who practice the diagnosis and treatment of malignant disease.

—*H. HASKELL ZIPERMAN, Lt. Col., MC, USA*

ORAL ROENTGENOGRAPHIC DIAGNOSIS, by *Edward C. Stafne,* D.D.S., F.A.C.D. 303 pages; illustrated. W. B. Saunders Company, Philadelphia, Pa., 1958. Price $14.50.

As the author predicts this "volume will be of particular value to dentists, especially those who choose oral roentgenology as a specialty."

A rare advantage to the reader stems from the author's association with a medical clinic frequented by many patients suffering from systemic diseases. One chapter of 50 pages, with a bibliography of 65 references is devoted to the dental manifestations of some systemic diseases. Nearly every condition which can be demonstrated radiographically is adequately covered in this volume. The discussion of each pathologic condition is opened by a descriptive definition. The etiology (occasionally genetic), pathology, and sometimes treatment are provided in a thorough and easy to read treatise.

The volume is profusely illustrated. Each illustration is fully elucidated by the explanatory lines and the text. Every dentist should have this volume in his professional library. An occasional review may lessen the diagnostic error common to all of us upon routine examination of dental roentgenograms. —*HAROLD E. DILLEY, Col., USAF, (DC)*

ELECTROLYTE CHANGES IN SURGERY, by *Kathleen E. Roberts,* M.D., *Parker Vanamee,* M.D., *J. William Poppell,* M.D. 113 pages. Charles C Thomas, Publisher, Springfield, Ill., 1958. Price $4.50.

In this small volume, written by eminent internists, based on clinical experience with many surgical patients, basic physiology is presented in relation to certain clinical conditions occurring before, during, and after operation. Some of the practical subjects discussed include electrolyte changes occurring preoperatively as a result of bowel preparation, diarrhea and chronic illness; a useful method of estimating whether blood volume has been restored when laboratory facilities for blood volume determinations are not available; complications arising with the use of massive blood transfusions; postoperative changes in water and electrolytes; alterations in the acid-base balance in surgical patients (a concise table of differential diagnosis of metabolic and respiratory acidosis and alkalosis, and metabolic situations with pulmonary insufficiency); complications of removal of gastric or intestinal segments (the physiology and suggestions for treatment of the dumping syndrome is presented); hepatic failure, ascites and edema, and the role of elevated blood ammonia; mechanism of etiology and the treatment of patients with acute and chronic renal disease, ureterosigmoidostomy, and acute renal shutdown. In general this is an exceptionally good, practical, and up-to-date handbook for the diagnosis and treatment of the problems encountered in electrolyte changes in surgery.

—*PHILIP A. COX, Lt. Col., USAF (MC)*

ATLAS OF TECHNICS IN SURGERY, by *John L. Madden,* M.D., F.A.C.S., with 62 contributing authors. 648 pages; illustrated. Appleton-Century-Crofts, Inc., New York, N.Y., 1958. Price $30.

This volume presents most adequately the author's primary aim of presenting in beautiful detail his technic in a large variety of procedures usually considered to be in the domain of the general surgeon, by means of drawings by the medical artist, Alfred Feinberg. Each procedure is discussed by a qualified expert to help balance in the reader's mind the many accepted variations in technic of the procedure under discussion. The embryo surgeon develops through many modalities of learning but certainly the visualization of a surgical technic through the

pen of an artist, thoroughly monitored by an experienced, mature surgeon is not the least of these highly disciplined modalities. The author does not attempt to develop a complete format for procedures of the neck, chest, or abdomen but is interested in presenting those technics with which he has had personal experience and would be of sufficient importance to the trained practicing general surgeon as well as the younger man. I believe this volume will prove to be a frequent source of reference for a concise, rapid review of procedures infrequently performed. The layout of the explanatory text, on a facing page to the drawings, is most acceptable to the reader. There is no lost effort in following the successive sketches of each technic. This volume is highly recommended for the surgeon's reference shelf.

—DAVID GOLD, Col., USAF (MC)

TREATMENT OF BREAST TUMORS, by *Robert S. Pollack,* M.D., F.A.C.S. 147 pages; illustrated. Lea & Febiger, Philadelphia, Pa., 1958. Price $6.

This book fulfills a great need to consolidate in one handy volume information on the classification, pathology, diagnosis and treatment of benign and malignant tumors of the breast. It is brief and to the point. It includes a comprehensive yet simple classification of tumors, together with excellent photomicrographs and gross illustrations of some of the lesions. Practical points, such as breast biopsy, draining sinuses, chronic cystic mastitis, and breast incisions are also discussed. There are clear illustrations of the surgical technic of radical mastectomy to include resection of the internal mammary lymph nodes. There is a discussion of the controversy concerning radical versus simple mastectomy, with the sound recommendation that up to the present time radical mastectomy offers the best chance of cure. There are chapters on radiotherapy, oophorectomy, hormone therapy, hypophysectomy and adrenalectomy. The latter includes a description of the surgical technic. In general this is a practical volume which would be most useful in the library of every surgeon who treats tumors of the breast. If there is a criticism of the book, it would be that some readers will yearn for a little more detail and discussion from the author who presents his subject so clearly and practically.

—ROBERT M. HARDAWAY, III, Lt. Col., MC, USA

PEDIATRIC CLINICS OF NORTH AMERICA, Symposium on Pediatric Cardiology, November 1958, *Alexander S. Nadas,* M.D., Consulting Editor. 1234 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., 1958. Price $15, per year of 4 books issued quarterly.

This is a symposium by various authors on pediatric cardiology and an index (1956-1958) to the *Pediatric Clinics of North America.* The volume includes four chapters on diagnosis, five chapters on the "clinical profile" or clinical-physiologic correlation, and four chapters on treatment in pediatric cardiology. This symposium is well illustrated by photographs and reproductions of electrocardiograms, phonocardiograms, and roentgenograms. The section on auscultation of the heart discusses various physiologic and pathologic heart sounds in detail with explanations of their etiology and significance. The monograph on

electrocardiography deals with this subject in general plus those ECG aspects peculiar to infants and children. The electrocardiographic features of various congenital heart malformations are discussed in detail. There is a chapter on cardiac catheterization giving technic in particular plus various biochemical measurements and a discussion of angiocardiography. The morbidity and mortality of cardiac catheterization is also covered. One portion of this book deals with cine-cardioangiography, a method of combining cardiac catheterization with the injection of multiple small doses of contrast media into any heart chamber or into the great vessels. The fluoroscopic image during these procedures may be transmitted by a television system and may be permanently recorded by motion picture photography. A valuable monograph provides clinical-physiologic correlation in the diagnosis of congenital heart disease. The clinical features of cardiac differential diagnosis are particularly stressed. There is a monograph on heart disease in the newborn and a chapter on the use of hypothermia in pediatric cardiac surgery. The diagnosis and surgical therapy of transposition of the great vessels is well covered. The final two chapters deal with the management of cardiac failure and rheumatic fever in infants and children. This book is recommended for all students of pediatrics, internal medicine, and cardiology. It is an excellent review and "refresher" for those who have completed their formal training in these subjects. The volume represents a very readable summary of present day aspects of pediatric cardiology.—*BYRON A. NICHOL, Col., MC, USA*

CARDIOVASCULAR SOUND IN HEALTH AND DISEASE, by *Victor A. McKusick*, M.D. 570 pages; illustrated. The Williams & Wilkins Company, Baltimore, Md., 1958. Price $15.

This is the most complete monograph known to the reviewer on the subject of cardiovascular sounds and auscultation of the heart. Although primarily a monograph on this subject, it is in many respects a textbook of cardiology. The discussion of the basic considerations of auscultatory sounds includes their physical and physiologic interrelationships wherever the present state of knowledge makes this correlation possible. Detailed descriptions and interpretations are given of the various auscultatory findings encountered by the clinician, and the so-called normal sound variations, murmurs of all types and causes; normal and abnormal auscultatory sounds associated with and caused from disease of the pericardium, disease of the myocardium, hypertension and pneumothorax. Spectral phonocardiograms supplement this material throughout the book. As the author indicates, the golden age of auscultation began to wane some years ago with the event of x-ray, catheterization and angiocardiography. However, as all thoughtful practitioners know there still remain many things to be learned from the careful examination of the heart by auscultation. For interesting relaxed reading, the book will appeal to all physicians. As a comprehensive reference on normal and abnormal cardiovascular sounds, their genesis and significance, it is complete and thorough. As a bibliography on the subject of cardiovascular sound in health and disease, the reader will find Dr. McKusick's work is without peer.—*FRANK L. BAUER, Col., MC, USA*

MANAGEMENT OF COMPLICATIONS IN EYE SURGERY, Avoidance of Pitfalls and Treatment of Difficult Situations in Ophthalmologic Operations, edited by *R. M. Fasanella*, M. D. 422 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., 1957. Price $17.

This book is a compendium of material of 20 distinguished physicians in the United States, 18 of whom are ophthalmic surgeons. The other two specialties represented are radiology and internal medicine. Each member of this group has contributed a chapter, which, when combined and edited by Dr. Fasanella, an ophthalmologist, becomes a most authoritative and straightforward book on eye surgery and its complications. The objective of this book is to point out pitfalls and complications in eye surgery. Particular emphasis is placed on the pitfalls and their avoidance as a true basis for preventing complications in eye surgery. Individual chapters deal with complications in the realm of anesthesia, medicine, psychiatry, and radiation; others discuss the complications of the subspecialties in ophthalmology, such as intraocular foreign bodies, ptosis, trauma, keratoplasty, glaucoma, cataracts, retinal detachments, orbital surgery, plastic surgery of the adnexa, and extra ocular muscle surgery. The chapters, "Endocrine Exophthalmos," "Estimation of Loss of Visual Efficiency," and "Rehabilitation of the Low Vision Patient," are of particular importance to ophthalmic surgeons because of the ever increasing pension consciousness that exists in our society. One of the outstanding things about this book is its "forward look." Obsolete technics and material are omitted and emphasis is placed on new, sound surgical technics. The book is well illustrated by many drawings and reproductions of x-rays and photographs. The bibliography is excellent. This book is enthusiastically recommended to all residents in ophthalmology, ophthalmic surgeons, as well as other physicians who perform surgery on the ocular adnexa or orbit. —*AUSTIN LOWREY, Jr., Col., MC, USA*

CLINICAL OBSTETRICS AND GYNECOLOGY, Volume 1, Number 3, September 1958. A quarterly book series. Symposium on Special Diagnostic Aids, edited by *C. Paul Hodgkinson*, M. D., and Symposium on Abnormal Uterine Bleeding, edited by *John L. Brewer*, M. D. 852 pages; illustrated. Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, N. Y., 1958. Price $18 for four consecutive numbers.

This book is the third of the quarterly offerings of a new publication of two parts; the first, *Special Diagnostic Aids* was edited by C. Paul Hodgkinson, and the second, *Abnormal Uterine Bleeding*, by John L. Brewer. The contributors are 46 noted authorities in obstetrics and gynecology, representing medical centers all over the United States. The first impression made on this reviewer by the concept of this book series was that it might serve a useful purpose in medical literature. Every few years the broad field of obstetrics or gynecology could be thoroughly and concisely reviewed to bring the busy practitioner of this specialty up to date. The subjects are broad in scope as well as their coverage. This proved to be, perhaps, the downfall of this issue in fulfilling the potential promise of wrapping this up completely;

throughout it was found to be superficial in its treatment of the diagnostic aids and the various causes of uterine bleeding. This criticism raises the question of for whom this quarterly series is intended. If it is intended for the specialist in the field it missed its mark. If this issue is representative of the series, then it would seem to have a definite value for the medical student and intern group. In literature designed for the specialist, this reviewer feels compelled to make a plea for better quality, rather than greater quantity.

J. WILSON HUSTON, Capt., MC, USN

THE YEAR BOOK OF GENERAL SURGERY (1958-1959 Year Book Series), edited by *Michael E. DeBakey*, B. S., M. D., M. S., with a section on Anesthesia, edited by *Stuart C. Cullen*, M. D. 588 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., 1958. Price $7.50.

This book, which contains abstracts of the articles the editor considers of most significance in the surgical literature during the past year, continues the fine performance of its predecessors. Cardiovascular surgery occupies an increasing percentage of the pages, which is consistent with the dynamic progress shown and the interest of many surgeons in this pioneering field. The comments of Dr. DeBakey emphasize the divergence of opinion which exists in many aspects of this field. The sections on tissue transplantation and nutritional management problems are excellent, as is that devoted to clinical and physiologic aspects of the stomach and duodenum. The section on anesthesia contains an excellent review of ventilation for the general surgeon. Recent advances in this specialty and newer anesthetic agents are reviewed critically. This annual summary of the surgical literature should be in every surgeon's library. It provides a year-by-year résumé of the developments in any particular problem, its references constitute an excellent starting point for a more exhaustive search of the literature, and its abstracts point out important contributions one may have missed in the complete article.

—DAVID E. THOMAS, Lt. Col., MC, USA

THE YEAR BOOK OF RADIOLOGY (1958-1959 Year Book Series); Radiologic Diagnosis edited by *John Floyd Holt*, M. D., and *Fred Jenner Hodges*, M. D. Radiation Therapy edited by *Harold W. Jacox*, M. D., and *Morton M. Kligerman*, M. D. 448 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., 1958. Price $10.

The new *Year Book of Radiology* follows the best traditions of its predecessors in clear and compact coverage of many well-selected articles from the recent extensive radiological literature. As such, it should have a wide appeal not only to radiologists but also to practitioners in other fields of medicine, since the radiological and the clinical features of many diseases are intimately intertwined. As in previous years, the current volume is divided into two major selections; namely, (1) radiological diagnosis and (2) radiation therapy. Selected articles in each are classified according to body systems. In addition, under radiation therapy there are subsections of radiation

biology, physics, isotopes, and hazards and injuries. The inclusion of several representative articles dealing with the problem of gonadal exposure in roentgen diagnostic procedures reflects the continuing concern of the radiologists with the problems of radiation hazards and with the matter of maintaining a sensible perspective in dealing with them. The 228 abstracted articles in the section on radio-diagnosis and the 160 in radiation therapy point to substantial contributions in their respective fields and attest to the broad scope of the book. The number of articles of "pressing clinical interest" in radiation therapy is less than in previous years despite extensive technical advances. The subsection on radiation biology is greatly expanded. One notes not without regret that one of the editors (F JH) is relinquishing his position after many years of distinguished service.

—HARRY L. BERMAN, Col., MC, USA

YEAR BOOK OF PEDIATRICS (1958-1959 Year Book Series), edited by *Sydney S. Gellis*, M. D. 496 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., 1958. Price $7.50.

The recent edition of this year book presents a fund of information for pediatricians and physicians interested in pediatrics. The editorial staff has succeeded in bringing together in one small volume a comprehensive coverage of some of the more important and recently published articles. Comments of guest commentators and the editor are especially valuable in summarizing current opinion on controversial subjects. Articles are grouped under some seventeen sections. Thirty-seven articles are devoted to premature and newborn infants. Of special value is a practical outline to guide physicians in controlling spread of the staphylococcus and in handling an outbreak of this infection. The section on infectious disease and immunity includes a number of interesting articles on generalized cytomegalic inclusion disease as a recognized disease of clinical importance. Adequate consideration has been given to nutrition and metabolism, orthopedics and endocrinology, and to the gastrointestinal and genitourinary tracts. Under the respiratory tract, physicians are made aware of the appearance in this country of pneumocystis carinni pneumonia, an infection of infants that is common in Europe. This volume provides the reader with a knowledge of current trends and thoughts in a wide range of subjects in the field of pediatrics. It is highly recommended.

—CONN L. MILBURN, Jr., Col., MC, USA

PATIENTS, PHYSICIANS AND ILLNESS. Sourcebook in Behavioral Science and Medicine, edited by *E. Gartly Jaco*. 600 pages. The Free Press, Glencoe, Ill., 1958. Price $7.50.

This book attempts "to bring together the writings, research, and ideas of representatives of the behavioral sciences on varied aspects of medicine within a single cover. . . ." While most of the contributors of the 54 articles are sociologists, cultural anthropologists, or social psychologists, a number of physicians are also represented. About one third of the articles are new while many of the others appeared originally in various social science journals not usually

encountered by professionals in the health fields. By excluding methodological studies and articles in the well-published field of social psychiatry, the editor has confined the book primarily to substantive material, much of which clinicians and medical administrators will find informative and, on occasion, entertaining. The book documents some of the ways in which the cultural background and socioeconomic class from which a patient comes can confound his ability or willingness to co-operate fully in the treatment prescribed. Armed Forces medical personnel who read this book will be disappointed to note a complete absence of studies and discussions which bring behavioral science to bear directly upon military medicine as such. Nevertheless, the thoughtful military reader will find promising behavioral approaches which can be adapted to the study of problems peculiar to medical practice in the Armed Forces.

—NORMAN A. HILMAR, Capt., MSC, USA

LEUKEMIA, by *William Dameshek*, M. D., and *Frederick Gunz*, M. D., Ph. D., 420 pages; illustrated. Grune & Stratton, Inc., New York, N. Y., 1958. Price $15.75.

This book reflects Dr. Dameshek's devotion to the ever-expanding field of hematology for more than thirty years, and in almost every page this reviewer can see the interest and hope for the future reflected by him and his coauthor. Many individuals and groups have done and are doing much in the study and treatment of this "dread disease," leukemia. The entire book is woven around the definition of leukemia as "a generalized, purposeless, self-perpetuating abnormal proliferation (slow or rapid) of one of the leucocytic tissues. often associated with abnormal white blood cell counts, and eventually leading to anemia, thrombocytopenia and death." The authors admit readily that there is less certainty now about leukemia than there seemed to be 20 or 30 years ago, but are not discouraged in seeking aids in diagnosis and treatment. The 16 sections of this monograph present the subject of leukemia in an orderly progression beginning with a brief history of it in the past; giving its definition and classification, and prevalence; its etiology and the pathology of the leukemic cell; its course and special pathology as related to symptomatology and clinical and special descriptive features; its differential diagnosis and laboratory findings; its relation to the "myeloproliferative" disorders; its prognosis coupled with counsel as to what one should tell the patient; its therapy and management; and finally a look as to what the future holds. It is repeatedly emphasized that there has gradually developed a distinct "know-how" in the various minutiae of diagnosis and good treatment which are difficult to record. These are acquired by much experience in the actual care of the patient. The authors point out that although a total *cure* for leukemia may never be achieved, the chance of keeping it under control for long periods of time, even for the normal life span of the individual is a distinct possibility.

—JOSEPH H. AKEROYD, Lt. Col., MSC, USA

ANNUAL REPORT OF THE SURGEON GENERAL, UNITED STATES ARMY, Fiscal Year 1958. Prepared by *The Office of The Surgeon General, United States Army*, Washington, D. C. 94 pages. U. S. Government Printing Office, Washington, D. C., publishers, 1958.

The first Surgeon General of the United States Army, James Lovell, who was appointed in 1818, made the first of these reports, and since then either in the copybook script of 150 years ago or printed, they have appeared annually. Major General Silas B. Hays, the present Surgeon General, begins this report with a useful summary of the principal achievements, during the year, that at once gives a bird's-eye view of the Medical Service's work to carry out its two main missions; one, to provide the best possible medical care to the soldier and military families in peacetime, and second, to furnish medical support in war. As this last includes atomic and even other types of war, the organization and training of special units for the task is described. Because of the prevalence of Asian influenza, the admission rate for all causes was higher than in the two preceding years. The cases were, however, mostly of brief duration and without serious complications or sequelae. Space does not permit the mention of but a few of the many points of interest in the report. New hospital construction and the extension and improvement of hospitals and dispensaries, training, personnel, administration, and research are of particular interest and importance.

—LOUIS H. RODDIS, Capt., MC, USN (Ret.)

BREAST CANCER, The Second Biennial Louisiana Cancer Conference, New Orleans, January 22-23, 1958; edited by *Albert Segaloff*, M. D. Sponsored by the American Cancer Society, Louisiana Division, Inc. 257 pages; illustrated. The C. V. Mosby Company, St. Louis, Mo., 1958. Price $5.

It is satisfying to have in one small book the opinions, and facts on which they are based, of 30 experts concerning the biology, treatment, and palliation of breast cancer. This is not a résumé of all previous literature, but an intensely practical and up-to-date report of a symposium. The presentations of the essayists are short and serve as a springboard for the most interesting, practical and applicable portions —the transcripts of the panel discussions, The editor, in his two-page summary, gives a few succinct conclusions, but in a form that is almost a narrative table of contents. The experience of the surgeon, pathologist, radiologist, endocrinologist, psychiatrist, biochemist, zoologist, epidemiologist, and virologist is presented in a lucid and simple fashion. All major facets of the problem of breast cancer are presented in a way that permits their application to clinical practice. This book can be understood and its principles applied by the intern and, at the same time, it is a delightful summation of the various disciplines to refresh the knowledge of the qualified, experienced surgeon. Any physician who is concerned with cancer of the breast will enjoy and profit by reading this book.

—DON S. WENGER, Col., USAF (MC)

AVIATION MEDICINE. An Annotated Bibliography. Volume 2, 1953 Literature. By *Arnold J. Jacobius, Madeline J. Wilkins, Ludmila Kassianoff, Rita B. Slie, Sam L. Whitehead.* Bibliography Section, Science and Technology Division, The Library of Congress. 354 pages. Published by the Aero Medical Association, 2642 University Avenue, St. Paul, Minn., 1959. Price $5.

This volume includes almost 1,400 abstracts and references from nearly 200 journals. A significant portion of the abstracts is from the foreign literature, including the Russian. The titles of these, as well as an English translation, are given. A cumulative author and subject index of both Volumes I and II is given. Much literature, not directly related to aviation medicine, but pertaining to problems of vision, circulatory and respiratory systems, polar climates and clothing is given. Many of the references are to papers published by military laboratories and not generally available in the journal literature. This is a thoroughly professional job and will be of great assistance to workers and practitioners in the field of aviation and and space medicine.—*PAUL K. SMITH, Col., USAFR*

MEDULLOBLASTOMA, by *Benjamin L. Crue, Jr.*, LCDR, MC, USN. A Monograph in The Bannerstone Division of American Lectures in Surgery. American Lecture Series, Publication Number 339, edited by *Michael E. DeBakey*, M. D., and *R. Glen Spurling*, M. D. A Monograph in American Lectures in Neurosurgery, edited by *Barnes Woodhall*, M. D. In two parts. First part: Pathological Aspects; Second part: Clinical Aspects of Incidence, Diagnosis, Treatment, Prognosis. 206 pages. Charles C Thomas, Publisher, Springfield, Ill., 1958. Price $5.75.

This monograph by a neurosurgeon is quite readable and has an almost doctor-talking-to-doctor-in-the-corridor quality about it. The bibliography is extensive, up-to-date and liberally sprinkled with references from the *Journal of Neurosurgery* and the *A. M. A. Archives of Neurology and Psychiatry* which together comprise more than a hundred of the 401 references. Throughout the book is a good deal of information about medulloblastoma and neoplasia which is presented in a concise and refreshing manner. In the clinical section the author points out that there is no double peak incidence of medulloblastoma at preschool and at puberty periods but there is, instead, a rather high incidence or plateau from three to ten years of age. There is an excellent chapter on symptomatology and diagnosis with a section on differential diagnosis which, in essence, lists other obstructive as well as nonobstructive lesions of the posterior fossa. It is concluded that medulloblastoma cannot be positively distinguished from these other lesions prior to operation. In the framework of theoretical discussion and examination of the lesser emphasized aspects of medulloblastoma, the author's intent of fitting in this particular neoplasm with the present day, but probably inadequate, concepts of neoplasia seems accomplished. The organization, cohesiveness and clear style of writing should appeal to those in the fields of neurosurgery, neurology, neuropathology, pediatrics and oncology.

—*ARTHUR J. LEVENS, Lt. Col., MC, USA*

New Books

RECENT STUDIES IN EPIDEMIOLOGY, by *J. Pemberton,* M. D., M. R. C. P., D. P. H., and *H. Willard,* M. D. 203 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $5.75.

FUNCTION OF THE HUMAN BODY, by *Arthur C. Guyton,* M. D. 584 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., 1959. Price $7.50.

CURRENT THERAPY-1959, Latest Approved Methods of Treatment For the Practicing Physician, edited by *Howard F. Conn,* M. D., with 12 consulting editors. 781 pages. W. B. Saunders Co., Philadelphia, Pa., 1959. Price $12.

THE HAND, It's Anatomy and Diseases, by *John J. Byrne,* M. D. 384 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $16.50.

NEW AND NONOFFICIAL DRUGS, evaluated by the A. M. A. Council on Drugs. 687 pages. J. B. Lippincott Company, Philadelphia, Pa., 1959. Price $3.35.

A HANDBOOK OF MEDICAL HYPNOSIS, An Introduction For Practitioners and Students, by *Gordon Ambrose,* L. M. S. S. A., and *George Newbold,* M. B., B. S., M. R. C. S., M. M. S. A., D. R. C. O. G., D. C. H., with forewords by *William Moodie,* M. D., F. R. C. P., D. P. M., and *William S. Kroger,* M. D. 2d edition. 276 pages. The Williams & Wilkins Company, Baltimore, Md., 1959. Price $6.75.

A PRACTICE OF THORACIC SURGERY, by *A. L. d'Abreau,* O. B. E., Ch. M., F. R. C. S. 619 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., 1959. Price $19.

UROLOGY IN OUTLINE, by *T. L. Chapman,* Ch. M., F. R. C. S., F. R. F. P. S. 176 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., 1959. Price $6.75.

STAPHYLOCOCCUS PYOGENES and its Relation to Disease, by *Stephen D. Elek,* M. D., D. Sc., Ph. D., D. P. H. 767 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., 1959. Price $15.

CONCISE DICTIONARY OF CONTEMPORARY HISTORY, compiled by *Sherwin Burickson,* with a foreword by *Harry Elmer Barnes.* 216 pages. Philosophical Library, New York, N. Y., 1959. Price $4.75.

DIFFUSE LESIONS OF THE STOMACH, An Account With Special Reference to the Value of Gastric Biopsy, by *Ian J. Wood,* M. D., F. R. C. P., F. R. A. C. P., and *Leon I. Taft,* M. B., B. Sc. 86 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., 1959. Price $6.

VASCULAR SPIDERS and Related Lesions of the Skin, by *William Bennett Bean,* M. D. 372 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $8.50.

THRILLS AND REGRESSIONS, by *Michael Balint,* M. D. 148 pages. International Universities Press, Inc., New York, N. Y., 1959. Price $4.

THE RORSCHACH and the Epileptic Personality, by *J. Delay; P. Pichot; T. Lempérière;* and *J. Perse.* Translated by *Rita* and *Arthur L. Benton* with an introduction by *Arthur L. Benton,* editor, and a commentary by *Zygmunt A. Piotrowski.* 265 pages. Logos Press, New York, N. Y., 1958. Price $6.

SURGERY OF THE SYMPATHETIC NERVOUS SYSTEM, by Professor Sir *James Paterson Ross,* K. C. V. O., LL. D., M. S., F. R. C. S., F. R. A. C. S., F. A. C. S. 3d edition. 170 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., 1959. Price $8.

MONOGRAPHS ON NEOPLASTIC DISEASE AT VARIOUS SITES, General Editor, *D. W. Smithers,* M. D., F. R. C. P., F. F. R. Volume II, Tumors of the Bladder, edited by *David M. Wallace,* O. B. E., M. S., F. R. C. S. 351 pages; illustrated. The Williams & Wilkins Company, Baltimore, Md., 1959. Price $11.50.

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES, Volume 72, Art. 12, pages 387-558, February 6, 1959. Editor-in-chief: *Otto V. St. Whitelock.* Managing Editor: *Franklin N. Furness.* Associate Editor: *Marguerite Selzer.* "Metabolic Factors in Cardiac Contractility," by *Menard M. Gertler* and *G. W. E. Plaut* (Conference Co-Chairman) et al. 171 pages; illustrated. The New York Academy of Sciences, New York, N. Y., 1959. Price $3.75.

YEAR BOOK OF PEDIATRICS (1958-1959 Year Book Series), edited by *Sydney S. Gellis,* M. D. 496 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., 1958. Price $7.50.

EGO PSYCHOLOGY AND THE PROBLEM OF ADAPTATION. Journal of the American Psychoanalytic Association Monograph Series No. 1, by *Heinz Hartmann,* M. D.; translated by *David Rapaport,* M. D. 121 pages. International Universities Press, Inc., New York, N. Y., 1958. Price $3.

OCCUPATIONAL ALLERGY, Lectures Held During a Course on Occupational Allergy under the Auspices of the *European Academy of Allergy.* 329 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $10.

RENAL CIRCULATION IN ACUTE RENAL FAILURE, by *Ole Munck,* M. D. 54 pages; illustrated. Blackwell Scientific Publications, Oxford. Distributed by Charles C Thomas, Publisher, Springfield, Ill., 1958. Price $3.

BAILEY'S TEXTBOOK OF HISTOLOGY, revised by *Wilfred M. Copenhaver,* Ph. D., Editor, and *Dorothy D. Johnson,* Ph. D. 14th edition. 633 pages; illustrated. The Williams & Wilkins Company, Baltimore, Md., 1958. Price $11.

CLINICAL FLAME PHOTOMETRY, by *Henry A. Teloh,* M. D. 103 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $4.50.

PSYCHOPATHIC PERSONALITIES, by *Kurt Schneider.* 163 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $3.75.

COLOR ATLAS OF MORPHOLOGIC HEMATOLOGY, With A guide to Clinical Interpretation, by *Geneva A. Daland,* B. S. Edited by *Thomas Hale Ham,* M. D. 72 pages; illustrated by *Etta Piotti.* 16 color plates. Harvard University Press, Cambridge, Mass., 1959. Price $6.75.

TEXTBOOK OF PHYSIOLOGY AND BIOCHEMISTRY, by *George H. Bell,* B. Sc., M. D., F. R. F. R. S. G., F. R. S. E.; *J. Norman Davidson,* M. D., D. Sc., F. R. F. P. S. G., F. R. I. C., F. R. S. E., and *Harold Scarborough,* M. B., Ph. D., F. R. C. P. E., M. R. C. P. 4th edition. 1,065 pages; illustrated. Williams & Wilkins Company, Baltimore, Md., 1959. Price $12.50.

MATERNITY, A Guide to Prospective Motherhood, by *Frederick W. Goodrich, Jr.,* M. D. 130 pages; illustrated. Prentice-Hall, Inc., Englewood, N. J., 1959. Price $1.75.

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